ATTENTIONAL BIAS AND ADDICTIVE BEHAVIOUR

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ABSTRACT OF THESIS

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The relationship between attentional bias and aspects of alcohol use was investigated. A modified Stroop procedure was administered to detoxified problem drinkers (N=33) attending a specialist day clinic and staff specialising in substance misuse treatment (N=32). The card format Stroop procedure contained words such as "alcohol" and "relapse" and neutral semantically homogenous words. It was predicted that the problem drinking cohort would show greater colour naming latency with alcohol relevant words compared to the neutral words than the control group. It was also hypothesised that significant relationships would emerge between indices of alcohol consumption and Stroop interference. Analysis of variance revealed significant main effects for word type with both alcoholic and "expert" subjects taking longer to colour-name alcohol related words ($p < .001$). Predicted interactions between word type and clinical status of subject were not observed. This result was consistent with earlier findings that expertise or familiarity were influential factors in Stroop performance and highlights the need to control for this in future research with alcoholic subjects. Multiple regression analysis with the entire sample (N=65) showed that equations with the Severity of Alcohol Dependence Questionnaire (S.A.D.Q.), the average quantity of alcohol consumed per drinking occasion and the number of years regular drinking were significantly predictive of colour naming latency for alcohol related words ($p < .001$). The quantity of alcohol reportedly consumed on each occasion was negatively predictive of Stroop interference, contrary to prediction. Overall, the regression equation is consistent with an acquired information processing bias related to dimensions of alcohol use and dependence. Theoretical and clinical implications discussed include the role of automaticity in addictive behaviour and predicting and preventng relapse.

Acknowledgement

I wish to gratefully acknowledge the help I received from Professor Michael Eysenck and Professor Mick Power. I would also like to thank the clients and staff of Riverside Substance Misuse Service who agreed to participate in the study. The support and understanding of my colleagues throughout the period of study is also very much appreciated.

Declaration

I have composed this dissertation and the research on which it was based was conducted solely to fulfill the requirements of the DPsychol degree.

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"Life's aim, if it has one, is to be always looking for temptations."

Oscar Wilde

Introduction and Overview

Cognitive processes have become the target for investigation in a wide range of psychological disorders. It is now clear that individuals experiencing clinically significant levels of emotional or behavioural dysregulation tend to process information deemed relevant to their concerns differently from their unaffected peers. Thus, when depressed, a person will react differently when required to recall personal memories than when feeling less depressed (Clark and Teasdale, 1982); the anxious individual will react differently to a threatening experience compared to less anxious controls (Mathews and MacLeod, 1985).

With regard to substance misuse and addictive behaviour, therapeutic approaches based on learning theory and its derivatives have led to increased understanding of the mechanisms underlying the acquisition, maintenance and regulation of addictive behaviours. Historically, addictive behaviour was accounted for in terms of classical and operant conditioning processes (Wikler, 1948). This influence continues (e.g. Stewart ,deWit & Eikelboom 1983) but increasingly social learning theory (Marlatt and Gordon, 1985; Miller and Hestor,1989) has provided the integrative theoretical framework from which therapeutic interventions are derived. Predictably, cognitive products such as expectancies and attributions feature prominently in these accounts although they are essentially viewed as mediational factors intervening between stimulus and response.
The quest for greater understanding of the regulatory or mediational role of cognitive processes has gained momentum in recent years as experimental findings were applied to understanding and intervening with emotional disorders. (See Williams, Watts, MacLeod and Mathews, 1988 for a review). These authors preface their review by highlighting the distinction between *conscious* cognitive processes and their products (e.g. self reports) and *non-conscious* processes such as encoding or retrieval. They assert that procedures developed in therapeutic practice (e.g. Beck , Rush, Shaw & Emery, 1979; Beck and Emery , 1985,p.8) , while often robust in the clinic, give "conceptual primacy" to conscious cognition at the expense of non-conscious processes.

Even if more recent schema-based therapies (e.g. Young, 1990; Padesky 1994) imply that schemata formed in response to early vulnerability experiences are not reportable until the "discovery" process of therapy is at work, the emphasis remains firmly on the *products* of such structures (e.g. negative thoughts or dysfunctional assumptions) rather than *processes* such as selective retrieval or attentional bias. Brewin (1988) refers to experimental cognitive psychology and social cognitive psychology as traditions which respectively focus on information processing *per se* and on a narrower agenda based on phenomena such as expectancies which can be accessed by self-report.

The duality of cognitive systems proposed by theorists (e.g. Eysenck, 1992; Williams et al, 1988; Brewin, 1988; Dixon 1981) has led to speculation about the possible role such systems might play in the regulation of behaviour. The origins of such theorising, however, lie firmly in the cognitive psychology laboratory with awareness of psychotherapeutic applications coming later. A typical experimental study (Shiffrin & Schneider, 1977) used varied or consistent mapping in a visual search task to demonstrate the relative strengths and weaknesses of what were termed *controlled* and *automatic* processes.

Control processes are conscious, flexible and effective at dealing with variable, novel situations but have limited capacity and are therefore slow. Automatic processes are , once established, fast and, by definition, autonomous as well as being relatively resistant to overload but not capacity-free as evidenced by colour naming delays in tasks such as the emotional or modified Stroop paradigm (e.g. Mathews & MacLeod, 1985) which will be looked at in more detail below. Further, as has been demonstrated by Shiffrin and Schneider (1977) automatic processes can disrupt controlled or conscious processing while remaining relatively resistant to strategic manipulation.

More recent accounts have emphasised the continuous nature of automaticity (Cohen, Dunbar & McClelland, 1990; MacLeod & Dunbar, 1988), based on both simulated and empirical data. Thus a novel task can initially fulfil the criteria associated with controlled processing in terms of speed (or its absence) and capacity but can acquire the attributes of automaticity with practice. In this connectionist framework the evolution of automaticity is based on a gradual transition of information processing from "indirect" to "direct" pathways, corresponding in part to the controlled - automatic distinction but not sharing the implied dichotomy.

Leaving aside these important questions for the moment, the implication in the present context is that it is possible for automatic (or direct) processes to produce the same outcomes or effects regardless of whether these are " in concert with or in opposition to one's intentions " (Jacoby, Ste-Marie and Toth 1993 p. 277). While this assertion did not directly address addictive behaviour, the implications are nonetheless relevant: to those who experience or observe this behaviour it is often the case that it occurs regardless of prior undertakings to the contrary, however robustly stated. Intentionality and its limits bring the idea of *choice* into focus or, in informational terms, "the narrowing down of alternatives" (Neisser, 1967, p.7). This also has a strong, if originally unintended, resonance for the subject matter of the present study, which it is now appropriate to introduce.

As a starting point, it is asserted that models of human cognitive functioning have clear relevance to addictive behaviour although at the inception of the present study this was not reflected in the available literature. The present study sought to place this presumed relevance on an empirical basis. Firstly, the possibility that individuals with clinically significant alcohol problems would show evidence of attentional bias inferred from performance on a modified Stroop procedure was investigated by comparing their performance to a selected control group. Secondly, the nature of the

relationship between any observed Stroop interference and *indices* of the severity and chronicity of alcohol problems was explored.

PSYCHOLOGICAL ASPECTS OF ADDICTIVE BEHAVIOUR

The spectrum of addictions common in contemporary society is the largest preventable cause of morbidity and mortality. With regard to alcohol misuse and dependency, indications are that there has been a steady increase in *per capita* consumption since 1945 with a proportionate escalation in associated medical, social and psychological problems. Recent survey data emphasise that regular alcohol consumption is the norm with only 7% of men and 14% of women reporting that they *never* drink alcohol (General Household Survey, 1994). This survey also highlights the frequency of self-reported drinking in quantities associated with negative health consequences: for instance nearly one third of men in the 16-45 age group regularly drink more than 21 standard units per week. Estimates based on this survey suggest that 7% of the adult population can be classed as problem drinkers.

Approaches to understanding alcoholism have been categorised as follows:

Moral-volitional model
Personality model
Dispositional disease model
Alcoholics Anonymous model
Miller & Kurtz (1994)

Respectively, these models depict the alcoholic as immoral, immature, helpless (due to genetic or biologically determined factors) and spiritually bankrupt. The pejorative tone is perhaps accentuated by the cryptic summary which nonetheless reflects what were genuine attempts to explain puzzling and apparently self-destructive behaviour. In socio-medical domains the second and third models have informed treatment approaches emphasising the irreversible disease-like characteristics such as progressive loss of control (Jellinek, 1960). This approach has retained its influence and the imperative of verbal acknowledgement of the problem remains manifest in contemporary treatment approaches (e.g. Gorski & Miller, 1986). Reluctance to do this was frequently interpreted as "denial", the strength of which was assumed to correlate with the severity of the problem. Uniquely perhaps, this disorder was characterised by an inverse relationship between the self-reports of the afflicted and the considered opinion of the appraiser.

Psychologists have attempted to account for addictive behaviour by applying models from learning theory. Two important premises defined these efforts: recognition of the role of environmental events or contingencies and a dimensional view of addictive behaviour implying variation and reversibility. In contrast to the traditional disease model which in effect set the addict apart from the general population by virtue of pathological genetic, physiological, personality or even spiritual features, the psychological view implied a continuum of drug using behaviours along which the controlled social drinker or recreational drug user would differ from the problem drinker or drug taker in mainly quantitative terms. At least two strands of evidence support this view. Firstly there is extensive evidence of individuals deemed alcoholic resuming drinking in apparently controlled ways, although pronouncements of this nature become more equivocal the longer the follow up period is (see Heather and Robertson, 1981 for a detailed review). Secondly, and more directly, researchers have demonstrated that alcoholics can regulate their drinking. Mello and Mendelson (1972), for example, demonstrated that inpatient alcoholics deferred gratification when allowed to earn tokens which could be exchanged for alcohol: they remained abstinent for days in order to accumulate tokens for alcoholic binges. Leaving aside the ethical aspects of this study, it does provide evidence that refutes the hypothesis that there is loss of control in some absolute sense. The issue of control or self-regulation remains crucial in accounting for and responding to addictive behaviours however and it certainly appears safe to conclude that control is impaired, but not absolutely in specific contexts.

This does not discount the possibility of individual dispositional factors influencing the development of addictive disorders although identifying these requires prospective research methods. Vaillant (1983) highlighted the role of socio-cultural factors rather than individual psychological variables (with the significant exception of childhood conduct and attentional problems) in his account of an impressive longitudinal study spanning more than thirty years. Evidence pointed to parental alcohol abuse leading to emotional and behavioural disturbance in offspring who were in turn more at risk of alcohol problems in adulthood. Thus it could be concluded that the observed relationship between adult mental health problems (Glass & Jackson, 1988, reported this to be up to 40%, albeit with a hospital rather than a community sample) and alcohol problems is due in part to parental alcohol abuse which was in part fostered by cultural mores uncritical of such behaviour or yet more familial alcohol abuse. Further discussion of these issues has to be curtailed in the present text where the focus is on adults with established and chronic alcohol problems.

In this regard it is therefore necessary to qualify the dimensional view of alcohol use disorders referred to above. Individuals who progress along a continuum of increasing alcohol abuse culminating in referral for specialist help report common patterns of alcohol consumption (e.g. drinking to relieve withdrawal symptoms) together with emotional, neuro-cognitive, interpersonal, medical and social problems that are by convention grouped together as a syndrome. This is in essence what clinicians, and their clients, commonly refer to as alcoholism. The cognitive and behavioural aspects of the syndrome remain *relatively* malleable however and thus provide the rationale for therapeutic intervention.

Behavioural and Cognitive factors and Addictive Behaviour

As discussed in the foregoing addictive behaviour attracted the interest of psychological researchers who applied a learning theory framework. The paradigms used reflected those in mainstream experimental psychology. Early work (e.g. Wikler, 1948) generally applied conditioning models but increasingly cognitive social learning models have been applied (e.g. Marlatt & Gordon, 1985). Both of these traditions have generated therapeutic applications in the form of *cue exposure* and *cognitive behavioural therapy* respectively. The dichotomy is arbitrary to some extent as both approaches are rooted in learning theory and the pivotal role ascribed to craving in the social learning account. It is justified however by the contrasting therapeutic applications that have been derived: cognitive behavioural applications tend not to formalise cue exposure procedures, instead relying on naturalistic exposure to environmental cues to establish beliefs that craving, while difficult to resist, is responsive to effortful coping given the necessary coping repertoire. The reader is referred to Wilson (1987) for a more detailed account of cognitive factors in understanding and treating addictive behaviours.

Cue Exposure

Therapeutic interventions based on exposure to stimuli linked in the learning history with drug using behaviour aim to neutralise the conditioned reactions to salient drug cues in a manner analogous to exposing a phobic individual to their feared stimulus. While cue exposure does not eschew the role of cognitive events and products (Niaura, Rosenhow, Binkoff, Monti, Pedraza and Abrahms , 1988) , neither does it lose sight of its behaviourist origins. Conceptually at least, conditioned cue reactivity (CCR) can occur in an essentially non-verbal, situationist mode. CCRs are assumed to reflect the psychobiological stratum of craving manifested commonly in sub-clinical withdrawal states. In this sense it contrasts with, or perhaps complements, models that highlight the role of cognitive factors (e.g. Marlatt & Gordon, 1985). An important difference between cue exposure in addiction and in conditions where anxiety is prominent was pointed out by Powell, Gray, Bradley et al (1990): in addictive disorders a CCR can be appetitive whereas in anxiety disorders it is aversive. While CCRs can lead to aversive states in the absence of the consumatory response, remediation is achieved by an approach behaviour rather than an avoidance response. The incentive value of drug-relevant cues has featured prominently in recent accounts of the role of conditioning in resumed or ongoing drug use (Stewart, de Wit and Eikelboom, 1984). Drawing on behavioural and neuro-pharmacological findings Stewart and her colleagues have concluded that conditioned stimuli acquire incentive properties that mimic the positive affective consequences of opiate and stimulant drugs, and by implication other drugs including alcohol.

In contrast to earlier accounts of the persistence of drug taking which emphasised the role of avoidance learning or negative reinforcement in the resumption of drug use (see Wikler, 1948; Wikler and Pescor, 1967; Siegal, 1975), an appetitive motivational

theory can account for relapse into drug use in the absence of withdrawal symptoms or physical dependence. Critics of this approach (e.g.Tiffany, 1990) have pointed out the neglect of operant conditioning mechanisms in accounting for the acquisition of drug seeking behaviours by animals and human subjects, invoking the need to apply models of learning that incorporate both classical and operant mechanisms in a cognitive framework. It should also be borne in mind that much of the earlier work by researchers such as Wikler and Siegal used animal subjects, which calls into question the generalisability of such work, particularly when a role for information processing is included.

Social Learning Theory

From a social-learning theory perspective, the interaction between the individual, the drug and the environment has been the focus of recent investigation of the process of relapse or reversal of treatment gains. The influential model proposed by Marlatt and Gordon (1985) and referred to above highlights the role of so-called high-risk situations in increasing the likelihood of resuming addictive behaviour patterns. Influential in determining the outcome of these encounters are four categories of cognitive processes: efficacy expectations, outcome expectancies, and attributions of causality and decision-making processes. An individual who has habitually consumed alcohol, for instance, in socially challenging situations would typically report positive expectancies regarding this behaviour as a coping strategy in the absence of more potent self-efficacy beliefs about his ability to cope without the drug of choice. Combined with attributions that causally link drinking alcohol with sociability in addition to distortions in decision-making (e.g." seemingly irrelevant decisions") this pattern of expectancies paves the way for relapse. Following this initial resumption of drug use, which can be regarded as a first stage of a *process* of relapse, the individual engages in a more elaborate appraisal of the situation. This second stage was crucial in determining the parameters of the relapse: if the first lapse was attributed to relatively uncontrollable and stable factors (an apt example of this would be a belief system based on a disease model of alcoholism emphasising its irreversibility and possible genetic origins), a negative affective reaction (the Abstinence Violation Effect or AVE) ensued. Guilt or hopelessness in turn led to positive outcome expectancies regarding further indulgence alleviating the emotional distress.

Therapeutic interventions initially focus on the cognitive factors with re-structuring or re-appraisal as necessary. Anticipating scenarios where the client reports a combination of outcome and efficacy beliefs that increase the risk of engaging in the proscribed behaviour is the aim at this stage. Equipping the individual with the requisite skills to cope with these situations is the principal therapeutic currency. One of the strengths of this model is therefore the direct manner it can be applied to devise focused therapeutic interventions which can include both cognitive re-appraisal and the enhancement of the participants' coping repertoire. Further, by conceptualising relapse as a process beginning with a "lapse" the model avoids endorsing the myth of "one drink, one drunk" and therefore provides the client with a second opportunity to deploy coping skills taught in therapy.

Beck, Wright, Newman & Liese (1993) provide a more cognitive account of events such as relapse by emphasising the role of dysfunctional, facilitative beliefs e.g. "I need a drink to be happy" which can interact with schematic beliefs about personal worthlessness or unloveability. It therefore accords a less influential role to situational or environmental factors. This approach is essentially an application to substance misuse problems of the concepts and techniques applied widely to emotional and personality disorders by Beck and his colleagues (e.g. Beck et al 1979; Beck, Freeman et al (1990).

Empirical Findings

(i) ***Marlatt & Gordons Relapse Prevention Model (1985)***

Both classical conditioning and social-learning theory derived accounts of addictive behaviour and relapse have generated large bodies of empirical findings experimentally and clinically, most of which is beyond the scope of the present review. Of relevance in the present context is the cognitive processing dimension of cue exposure, specifically with regard to processing bias. Before reviewing relevant findings from a cognitive perspective more general research evidence bearing on cue exposure and more cognitive orientated approaches will be discussed.

Empirical support for the Marlatt and Gordon (1985) model comes from questionnaire data gathered from addicted individuals following relapse. Based on the findings, relatively little weight is accorded to the role played by cue reactivity *per se* as a determinant of resumed drug-taking. The key determinant is the valence of the outcome expectancy associated with drug-paired cues in specific situations: positive outcome expectancies facilitate the generation of craving, urges and actual drug use; negative expectancies will not. This is consistent with the finding that both positive and negative expectancies about the effects of alcohol on subsequent mood and behaviour are reliably and congruently associated with actual drinking behaviour (Brown, 1985). Further, expectancies are predictive of post-treatment progress (Jones & McMahon, 1994).

Heather, Stallard and Tebbutt (1991) challenged this apparent emphasis on the cognitive mediation of situational events or emotional states as antecedents of relapse rather than substance cues *per se.* They partially replicated Marlatt & Gordon's (1985) study and questioned the procedure used in evaluating drug users self-reports of recent relapses. Heather et al (1991) found that individual drug-users rated substance cues (e.g. "When I saw works or heroin I just had to give in") as the most influential precipitant of relapse whereas trained raters (albeit with only a 63% rate of agreement) judged this to be of little or no importance. The raters tended to account for matters in a manner more consistent with Marlatt and Gordon's (1985) model i.e. attributing relapse to negative emotional states and social pressure. In a further commentary on this subject Tiffany (1992) pointed out that the questions posed in the Heather et al. (1991) study do not in fact directly address craving or urges. While there is an implied compulsion to use in the above example (". I just had to give in") Tiffany (1992) interprets this as consistent with the addicts' recognition of their response being stimulus bound but not necessarily urge driven and presumably regulated by relatively

automatic cognitive processes. There is no valid means of adjudicating on this issue without further empirical data. In fact the model described by Tiffany (1992) has yet to be subjected to direct experimental testing although Tiffany (1990) specifies a number of ways in which this could be done.

In any case the two explanatory frameworks are not necessarily mutually exclusive: substance cues are " the final common pathway" (Cooney, Gillespie et al, 1987) that can of course be preceded by a sequence of intrapersonal and environmental events such as those proposed by Marlatt and his colleagues. Combined with the self reports in the Heather et al (1991) study, evidence that CCRs can account for at least some of the variance of the severity or frequency of relapse (Rohsenow, Niaura et al 1990; Monti, Abrams et al 1990) points to the need for greater understanding of the role of cue reactivity in the therapeutic response to addiction.

Other difficulties with the Marlatt account of relapse include the failure to find the predicted differences in attributional styles between abstainers and relapsers, suggesting that lifestyle or situational factors accounted for much of the outcome variance. (Birke et al, 1990) Additionally, a problem with the concept of the AVE is that in proposing a relationship between commitment to abstinence and subsequent cognitive-affective reactions it implies that those with the *least* commitment or resolve for abstinence will be less affected by initial resumption of drug use and therefore less likely to proceed from the first stage to continually engaging in the behaviour. When the relationship between commitment and abstinence has been investigated (Hall, Harvassy and Wasserman, 1990) the evidence was that those with the most commitment were less likely to return to continued use following initial use and hence were less likely to relapse.

(ii) *Cue Exposure Applications*

Given the variable relationship between cue exposure and cue reactivity it is not surprising that research attempting to relate cue specific phenomena to therapeutic gains with clinical samples has produced conflicting results. Powell et al (1990) in a controlled study demonstrated a significant reduction in CCR and self-reported craving in a cohort of opiate users given two laboratory based cue-exposure sessions. These findings were not replicated in a subsequent study (Dawe, Powell et al 1993) despite increasing the number of cue exposure sessions to six and including an in vivo component with some participants. When the recipients of the exposure therapy were compared with controls who were offered similar conventional inpatient care minus the cue exposure, both groups displayed significant decrements in craving in response to cue exposure. Outcome at six weeks and six months follow-up was similar for both groups. The authors speculate that the therapeutic milieu to which both groups were exposed allowed for frequent and prolonged exposure to salient cues, thus masking the effects of the formal cue exposure sessions. Weekend home visits were also allowed towards the end of the programme, thus increasing the possibility of deconditioning occurring. Given the potentially infinite permutations of cues available, even in the hospital setting, it would be difficult, if not impossible, to control for naturalistic or opportunistic exposure. As investigation of cognitive processes was beyond the scope of this study, the possibility that the assumed

ubiquity of cues manifested selective or biased attentional processing was not discussed by the authors. It highlights the need for a more precise account of the role of cognitive processes in this and similar post-treatment scenarios.

Further problems for theories of drug use which emphasise the role of conditioning as manifested in the CCR were highlighted by Tiffany (1990). He argued that if CCRs were indeed reflective of the neurobiological substrate of addiction, strong relationships between aspects of CCRs such as self-reported urges and physiological or behavioural components of drug use should occur. This was found not to be the case however. Of the 13 studies he reviewed where correlations between self-reported urges or craving and physiological responses such as skin conductance or heart rate were reported, the average coefficient was .38, rising to .52 when significant results only were included. A similar picture emerged when self-reported urges were correlated with alcohol use and cigarette smoking behaviour. Here the average correlation was .40, rising to .50 when only statistically significant coefficients were included in the calculation. Tiffany thus calculated that approximately 28% and 25% of the variance in physiological response to drug cues and actual drug using behaviour respectively could be accounted for by the magnitude of the self-reported strength of urge to use. Interpreting these data depends very much on the perspective that is adopted: while the relationships reported might fall short of what is theoretically possible, they can hardly be dismissed.

In conclusion, both clinical and experimental findings in cue exposure research suggest a complex pattern of cue reactivity among addicted individuals. This includes the absence of any detectable response and highlights the need to evaluate the role of cognitive processing variables in what is essentially a conditioning paradigm. Inferentially, from the work of Eysenck (1992) and others it also raises the question of cognitive avoidance. De Ruiter and Brosschott (1994), for instance, delineate a role for effortful cognitive avoidance in accounting for delayed colour naming of both negatively and positively emotionally valenced stimuli. Nonetheless, at least at the intuitive level, invoking an avoidance process seems less appealing in relation to addictive behaviour which is defined in terms of approach and acquisition. A cautious approach to accounting for response latency is certainly called for when findings such as that reported by Matthews & Sebastian (1993) are considered. This study found that snake phobic Ss displayed colour naming facilitation rather than the predicted latency in the actual physical presence of a snake leading the authors to speculate that this reflected either a narrowing of attention under conditions of heightened arousal or a prioritisation of the relevant cognitive processing in the face of the threat. This finding, if robust, has important implications for cue exposure and how it is investigated. What little evidence that exists with exposure to drug cues suggests that these disrupt rather than facilitate cognitive performance on competing tasks such as that devised by Droungas et al (1992).

The extent to which relatively automatised cognitive processes are influential in the regulation of addictive behaviour is at present unknown although, as will be seen below, evidence is accumulating that a processing bias might be implicated. While at present a cognitive processing account of addictive behaviour is not available, in contrast to anxiety disorders, for instance, a glance at the diagnostic criteria points to

the potential relevance of a cognitive framework. The ICD classification (WHO, 1992) depicts a behaviour pattern that is subjectively experienced as compelling in the face of overtly harmful consequences, consistently prioritised over other pursuits and difficult to control in terms of dosage or frequency of use. In a phrase derived from the concept of the Alcohol Dependence Syndrome (Edwards and Gross, 1976) another criterion is a "narrowing of the personal repertoire" of substance misuse. This is described as a pattern of substance misuse that remains relatively constant across different settings. These authors also refer to the salience of acquisitive behaviour in the context of alcohol dependency. In combination, these aspects of disordered substance use raise significant questions about the cognitive processes involved in a behaviour that is selective, preferential and apparently autonomous or uncontrolled. These questions will be addressed in the next section.

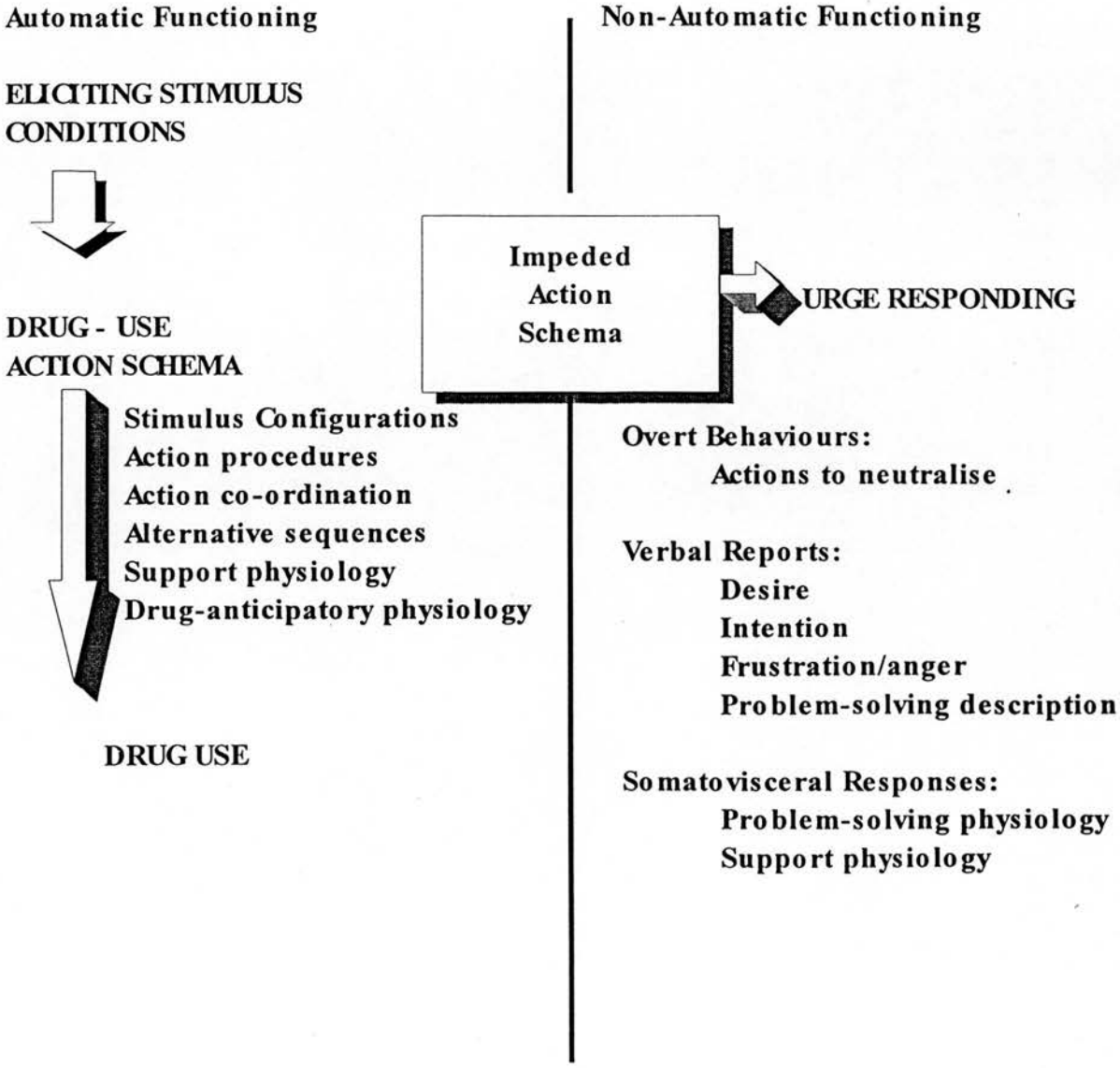
WHY STUDY ATTENTIONAL PROCESSES?

Selective attention to environmental and interoceptive stimuli has now been shown to be a fundamental attribute of human information processing. This is particularly the case when threat is adduced. It appears then that when an event is perceived as threatening a rapid redeployment of cognitive processing resources takes place. These changes can be involuntary and occur despite attempts at effortful control. A cognitive perspective has been fruitful in generating theoretical accounts such as hypervigilance theory (Eysenck, 1992) which delineates a role for pre-attentive and relatively automatised cognitive processes in maintaining clinical anxiety disorders. In the context of addictive behaviour, which is defined in part in terms of impaired control, the need for understanding the cognitive regulatory mechanisms is clear. Given the necessary selective nature of human information processing a logical starting point for investigation is whether such bias is detectable with stimuli deemed salient.

Again in common with the anxiety disorders, cue responsivity is crucially significant in understanding the regulatory dynamics of addictive behaviour. A corollary to this is that specifying a role for cognitive processes such as selective attention in relation to addictive behaviour is potentially as illuminating as parallel endeavours have proved with anxiety disorders. To date researchers in addiction have generally regarded the relevant cue as a stimulus feature presumably like any other but with the potential to elicit the necessary appetitive response through conditioning processes mediated by expectancies or other cognitive processes. This has informed clinical interventions such as cue exposure with mixed results (e.g. Powell et al 1990; Dawe et al, 1993). Thus a typical discussion in the consulting room would involve a detoxified client describing the ubiquity of cues, both environmental and interoceptive, that lead to thoughts of resuming alcohol or drug use. Given the present state of knowledge the therapist could not offer much more than the rather circular observation that either the client is "pre-occupied" with their drug or perhaps that it is difficult to avoid temptation in a drug orientated society.

Cognitive Factors and Cue Exposure

One crucial unanswered question is the non-reactivity of some alcohol dependent subjects: almost a third of whom fail to react with increased salivation when exposed to alcohol cues (Rohsenow et al, 1992). These findings question the usefulness of debating the role of craving through *post hoc* self-reports, attributions and observer ratings (Heather et al., 1992; Tiffany, 1992) where no attempt was made to directly measure craving or urges psychometrically, physiologically or behaviourally. Moreover it points to limitations in Tiffany's account which states that " some stimulus configurations" (Tiffany, 1992, p, 132) will elicit action schemata aimed at drug acquisition. In an attempt to apply a dual cognitive processing model to cue exposure in the context of drug taking, Tiffany (1992) emphasised the automatic nature of the drug acquisition and use cycle. According to this view, when the relatively autonomous drug using behaviour is impeded, controlled cognitive processing is deployed.



Cognitive processing model of cue reactivity (Tiffany,1990)

Figure 1

This of course assumes that the strategic objective is to satisfy the need. An important exception to this routine occurs in, for example, the course of treatment interventions. Here it is likely that the goal is to *interrupt the routine* and thus inhibit the consumatory behaviour. Here the default route is the completion of the sequence subserved by automatic processes but this can be subject to effortful and strategic control.

The account does not however speculate on what cognitive operations regulate the perception and detection of the stimuli and therefore overlooks a potentially crucial role for selective attention. It nonetheless allows Tiffany (1990) to propose a number of tests of the model. It is proposed, for instance, that a dual task paradigm where urge responding is involved and responding to a probe stimulus such as a tone is the secondary task will generate different outcomes depending on whether the former is regulated by automatised action schemata or not. If the primary task e.g. exposure to a drug relevant cue is regulated by relatively automatised processes as in the scenario where the subject not being impeded in satiation, the secondary task will be less compromised. Some partial support is forthcoming for this prediction. Sayette, Monti, Rohsenow et al (1994) demonstrated the disruptive effect of alcohol cues in response to tone probes. These findings support the notion that cue exposure can have a disruptive effect on information processing but a fuller test of the model would involve the manipulation of the drug using status of the subjects by creating a condition where individuals with unimpeded access to their drug of choice would participate in a dual task procedure, as indeed suggested by Tiffany (1990, p 160). Another proposed test of particular relevance in the present context is derived from the proposed automatisation of drug acquisition that is a core component of Tiffany's model. This, according to Tiffany (1990, p.162), suggests that indices of automatisation should be related strongly to the amount of usage or consumption (or practice in skill acquisition terms) that the user has had with their drug of choice.

On an anecdotal level, it is clear from the author's own clinical experience that individuals with addictive behaviour disorders frequently present as preoccupied with their drug of abuse and its environmental and cultural contexts. The present investigation was in part stimulated by the observation in a therapeutic group that a problem drinker became distracted from one task (reporting on the previous week's activities) when another client referred in passing to a previous alcoholic "binge". One possible interpretation of this disruption of the processing of the task in hand was to attribute a salience to the term "binge" that leads to preferential and relatively automatised processing.

Returning to the parallels in accounting for anxiety disorders, it is worth considering the level and specificity of advice that the putative client would receive. Here it would be possible to deliver a coherent account of the configuration of cognitive processes involved in the persistence of the disorder. Eysenck (1992, p.160), for example, outlines a necessarily incomplete but nonetheless coherent list of the cognitive effects in generalised anxiety disorders, panic disorders and post-traumatic stress disorders. An account of this nature would include reference to the fulcral role played by attentional processes and selectivity in maintaining a cycle of threat orientated thoughts, behaviour and affect. An attempt to provide an account of similar scope to an addicted individual is not possible given the present state of knowledge. In focusing on the role of attentional processes in addiction, the present proposed investigation aims to provide empirical evidence relevant to both theoretical accounts of addiction and the implied psychotherapeutic response. This is essentially the rationale of the present study.

MODELS OF ATTENTION

The regulatory function of attentional processes in the context of the control of action was specified in more detail by Norman and Shallice (1980; 1989). They proposed a higher level of control they referred to, as "The Supervisory System" was necessary to deal with situations involving:

1 Planning or decision-making.
2 Error correction or "trouble-shooting".
3 Novel sequence of actions.
4 Dangerous or technically difficult.
5 Overcoming a strong habitual response or the resisting of temptations. (Shallice and Burgess, 1993 p 174).

A problem with specifying categories is that all of the above situations can also be viewed as dimensional: a situation can be *relatively* novel, dangerous or tempting. This means that theoretical accounts need to specify the relative contribution of strategic and automatic processes make to the completion of a given task or the production of a particular response. As Wells & Matthews (1994) point out in their review (p36) failure to function appropriately could be due to either a very strong over learnt automatic response or a particularly weak degree of strategic control. This places the above categories proposed by Shallice and Burgess (1993) in context. In terms of situations involving planning, for instance, it is quite conceivable that planned operations can be influenced by earlier acquired, overlearned responses. In relation to the present investigation this issue is significant: individuals apply much planning in their efforts to overcome addiction or behaviour where control is impaired but the evidence points to the high level of failure in maintaining such change.

Looking at the clinical literature, a relationship between indices of cognitive responding and outcomes is beginning to emerge. Monti and co-workers (Monti, Abrahms, Kadden et al 1990) have found that response latency to alcohol refusal scenarios was predictive of outcome. Those evidencing differential longer latencies in generating a verbal account of an appropriate coping response to alcohol specific scenarios had poorer outcomes on follow-up. This implies that those who are relatively more challenged in generating an effortful response are more vulnerable to relapse, and not just because of general problem solving deficits. Placing this in a broader clinical context, Lindstrom (1992, p 30) concluded, that using the criterion of improved drinking behaviour, controlled studies have " *generally demonstrated only weak and short-term effects of alcoholism treatment* " (italics in original). In more quantitative terms this equates to about 15% of individuals sustaining abstinence from alcohol for three or more consecutive years 5-8 years following treatment (Helzer et al, 1985). If a more lenient criterion for relapse is used (less than say 10 problem drinking days) about 25% of problem drinkers can be classed as "unrelapsed"(Orford, Oppenheimer & Edwards, 1976). In general, evidence of the difficulty in maintaining changes is consistent with the proposition put forward by Wells & Matthews (1994) regarding the often unequal contest between over-learnt automatic processes and weaker strategic "supervisory" control. Shallice and Burgess (1993) use "overcoming temptation " (point 5 above) as an example of a situation where strategic or supervisory control needs to be deployed for effective coping to take place. Failure to cope would, according to this model, be linked to the executive or supervisory system not interrupting the activation of lower level (ie-automatic) schemas or routines.

Reason (1979) has surveyed the prevalence of these cognitive failures or "action slips" an example of which is searching for an item only to discover that it is in one's hand. Importantly, Reason (1993) demonstrated an increase in the reported frequency of these failures in stressful situations which he links to maladaptive resource management by vulnerable individuals. The relevant point here is that a cognitive variable, in this case a resource-intensive, relatively inflexible problem-solving strategy was apparently associated with raised levels of distress in response to stressful life events. In necessarily tentative terms, this is analogous to a post-treatment alcoholic finding a drink in his hand when pre-occupied with a stressful situation which diverts resources from strategic control of relatively automatised routines. This brief re-allocation of resources is enough to enable the latter to attain momentary primacy in regulating behaviour. Given the nature of drug-taking, this lapse can set the scene for a more prolonged phase of resumed drug use.

A significant feature of Tiffany's theory outlined above is the circumscribed role attributed to craving in the initiation or resumption of drug use. Tiffany (1992), maintained that craving is evoked only when the automatic drug acquisition routine is disrupted. In other words the behaviour will continue with little or no awareness or intentionality until it becomes apparent that the sought after substance is not available, at which point the individual becomes aware of craving. This cycle is triggered by stimulus configurations associated with drug use. The information processing cycle depicted in the model begins at this stage without acknowledging the role of any pre-attentional or selective biases. It therefore implicitly points to a response bias process at work with the individual apparently not altering his or her processing priorities.

The present investigation is a further attempt to relate an aspect of cognitive functioning in this case an indicator of attentional bias, to clinical parameters and outcomes of addictive behaviour disorders. From the standpoint of experimental psychology, attention has a rich provenance. Described in a recent review as " one of the central concerns of experimental psychology since its inception " (Cohen et al, 1990, p.332) these authors quote James (1890), who regarded attention as an essentially *selective* process and Posner (1975) who emphasised the *arousing* function of attention which again implies a preferential component to the process. These differences of emphasis have implications for psychological processes in general and addictive behaviour in particular. Regarding the latter, selectivity, in terms of salience of drug acquisitive behaviours, and arousal, in terms of cue conditioned states such as craving both are important.

In terms of a levels of control model (Shallice & Burgess, 1993) the aim (or at least the mechanism) of cognitive-behavioural therapy is to increase the control of the Supervisory system by increasing the probability of its effective deployment in an effort to control behavioural routines susceptible to relatively automatised regulation. A levels of control model based on a continuum of automaticity has particular advantages as a integrative framework for the purposes of the present study. This is partly because it allows rival conceptual models space within which to co-exist, with connectionist models showing promise in dealing with automatic processes (e.g. Cohen et al, 1990) but more traditional capacity and selection models remaining relevant for controlled or strategic processes (see Wells & Matthews, 1993 for a detailed review). As a heuristic position this is acceptable but serves to highlight the need for a more integrative account of a dual processing approach to cognition.

THE MODIFIED STROOP AND EMOTIONAL DISORDERS

Attention to emotionally significant stimuli has been the focus of recent investigation in a range of disorders where emotional or behavioural dysregulation is in evidence. Experimenters have applied a range of techniques and procedures to measure aspects of attentional allocation and deployment. Among the most widely used methods to assess attentional bias has been the modified Stroop procedure. It is based on the original task devised by Stroop (1935) which presented subjects with the inherently ambiguous task of naming the colour of the ink that a word is printed in which is at variance with the colour denoted by the word. The resulting interference led to significantly delayed colour naming compared to performance on a congruent version of the task. Experimenters subsequently demonstrated that this phenomenon was generalisable to words other than colour names. Klein (1964) found that colour naming latency was possible with most common words but particularly associated with terms such as "grass" semantically linked to colours. More recently the Stroop procedure has been used variously as an index of distractibility, interference or general emotional salience. Until the processes subserving the colour naming delay are better understood, interpretation of Stroop interference will remain inconclusive. There exists however a significant body of findings implicating Stroop interference in a range of clinical emotional disorders which will now be addressed.

Anxiety Disorders

Content specific colour naming latency has been demonstrated in a wide range of clinical disorders where anxiety and sensitivity to threat are involved. These include generalised anxiety disorders e.g. Mathews & MacLeod,(1985); post-traumatic stress disorder (e.g. Cassiday, McNally & Zeitlin,1992), social phobias (e.g. Mattia, Heimberg & Hope, 1993), panic disorder (e.g. McNally, Riemann & Kim, 1990) and obsessive-compulsive disorder (e.g. Foa, Ilai et al,1993). Furthermore it has been demonstrated that psychotherapeutic interventions impact on colour naming latency (Watts, McKenna, Sharrock, & Trezise, 1986), implying that the assumed attentional bias is implicated in therapeutic change. Moreover, evidence of delayed colour naming among high-trait anxious normals has been demonstrated (Mogg & Marden, 1990; Broadbent & Broadbent, 1988).

Typically then a Stroop investigation would involve the presentation of words related to fears or phobias and neutral words to a clinic sample and normal controls. The prediction generally was that a differential colour naming latency specific to the clinic sample and emotive words would occur. This has in fact been the case with all categories of anxiety disorder in a display of consistency unusual in cognitive processing research. Noteworthy also is the specificity of the colour naming impairment observed. In a well controlled study, Foa et al (1993) demonstrated that clients diagnosed with obsessive-compulsive disorder (OCD) evidenced colour naming latencies specifically relevant to their concerns. Those with contamination related obsessions linked to washing rituals were slower to colour-name words like *germs* or *toilet* compared to neutral words. The OCD clients with non-contamination symptomatology did not show this delay but did display longer latencies with general threat words such as *cancer*. Less conclusive findings were apparent regarding a priming manipulation and predicted relationships between clinical severity and interference were not observed. The primary finding showing the content specificity of Stroop interference is significant however particularly when it is recalled that, in addition to normals, the comparison group comprised OCD individuals manifesting different features of the same syndrome.

Post-Traumatic Stress Disorders

Evidence also points to the emotional Stroop effect being more marked with clinic populations than with community samples with experiences or features in common. Cassiday, McNally and Zeitlin (1992) reported that rape victims with PTSD performed more slowly on a trauma relevant Stroop task compared to non-PTSD diagnosed victims, who in turn performed more slowly than non-traumatised controls. Stroop interference was also statistically related to a self-report measure of intrusive cognition. This study was replicated and extended by McNally, English & Lipke, (1993) with a group of 24 Vietnam War veterans. These PTSD diagnosed men colour-named different categories of words as follows: control, neutral, positive emotional, OCD and relevant combat terms such as *bodybag* presumed to reflect combat related PTSD. The predicted Stroop effect was demonstrated solely with the PTSD terms. A number of methodological shortcomings were apparent in this study. Firstly, fatigue

may have been a factor as the Stroop procedure was presented in the same order for each S, with the PTSD stimuli always coming as the fifth and final trial. Secondly, the PTSD terms may well have been high frequency in the lexicon of the participants, thus confounding the attempts made to match the frequency of the terms to neutral words. The absence of a control group adds to these criticisms. McNally et al (1993) did however report a test - re-test reliability coefficient ($r=.80$, $p < .001$) having re-administered the Stroop procedure one week later. Considerably more modest and insignificant correlations were reported between standard self- report measures, clinicians ratings of severity and Stroop interference respectively.
One of the best controlled studies of PTSD using the modified Stroop was conducted by Thrasher, Dalgleish and Yule (1994). These researchers recruited survivors from the Zeebrugge ferry disaster and divided them into high and low PTSD categories. In addition to the clinical relevance of this manipulation, it enabled the researchers to control for "expertise" in colour naming disaster-related terms on the assumption that all survivors were comparable on this dimension by virtue of their shared traumatic experience. Neutral control words were selected from a homogenous semantic category as well as a set of unrelated terms. These two manipulations enabled the researchers to subsequently refute explanations of emotional Stroop interference attributed to familiarity with the emotionally salient words or semantic priming due to their homogeneity. This added to the robustness of the findings that high PTSD Ss evidenced marked interference on disaster words compared to low-PTSD Ss and non-traumatised controls. The authors concluded that the results provided evidence of a selective processing bias for the disaster-specific material compared to general threat, neutral or positive terms.

The fact that this latency differentiated high-PTSD from low-PTSD and controls five years after the trauma is of considerable theoretical and clinical import. The design does not, however, allow for a definitive explanation of the findings beyond the demonstration of clinically related processing bias. According to Thrasher et al, a failure to emotionally process traumatic experiences might be influential in slowing colour naming because evoked fear memories could disrupt the inhibition of the word reading impulse. Alternatively, chronic emotional disturbance could lead to biased processing of specific threat-related information which in turn disrupts more adaptive cognitive processing.

Eating Disorders

Beginning with the report of Channon, Hemsley & de Silva (1988) there is now a growing literature on cognitive processing by eating disordered individuals. The Stroop paradigm has again proved to be the most commonly used approach. Generally using food, diet and body-shape words a number of researchers have demonstrated colour naming delay linked to word content and clinical status or concerns of the participants (e.g. Ben-Tovim, Walker, Fok & Yap, 1989; Ben-Tovim & Walker, 1991; Fairburn, Cooper, Cooper, McKenna & Anastasiades, 1991). Colour naming decrements were not found to be confined to eating disordered individuals (Walker, Ben-Tovim, Jones & Bachok, 1992) but were also observed with normals displaying dietary restraint. In general however clinic samples could be distinguished from

normals due to their slower performance with salient words (Fairburn et al, 1991; Green & McKenna, 1993).

Taken as a whole, these data have been interpreted in a manner analogous to parallel findings in anxiety disorders i.e. indicative of a selective attentional bias linked to preferential processing of concern related terms. Impairments in colour -naming have been demonstrated with both primarily anorexic Ss (e.g. Channon et al, 1988) and amongst bulimic Ss (e.g. Fairburn et al, 1991). Clinically, it has been suggested that this selective tendency is involved in the maintenance of the disorder and can also be used as a quantitative measure of severity (Ben-Tovim et al, 1989). Walker, Ben-Tovim & Jones (1992) examined the repeat administration of the emotional Stroop with a sample of non-eating disordered women (n=60) and found only marginal mean differences between trials and across parallel versions. They did not report more conventional reliability data however and questions remain about the generalisability of the findings to clinical populations.

Summary

In summary it seems that Stroop interference is a robust, demonstrable phenomenon across a spectrum of emotional disorders, particularly, but not exclusively, where anxiety is involved. The semantic content of stimulus words does appear to impact on colour-naming times to a significant degree of specificity congruent with the presenting problems of the generally clinical populations studied. As will be seen in the next section however interpreting these findings is a less straightforward business.

THEORETICAL ASPECTS

As described above the modified Stroop research paradigm has been applied by researchers in a range of areas, generally where threat or anxiety is a component. Attentional bias implies *selectivity* and *specificity* in the detection of salient environmental events (including interoceptive feedback) and the differential resourcing of subsequent cognitive processing. Williams and co-workers (1988, p. 54) assume that attentional bias occurs when:

" *there is a discrete change in the direction in which a person's attention is focused so that he/she becomes aware of a particular part or aspect of his/her stimulus environment. We also assume that such a change (a) may take place in any sense modality; (b) is perceived as being passive or involuntary but can operate voluntarily; and (c) is normally perceived to be contingent upon a discrete change (onset or offset) in the 'internal' or 'external' environment of the person.*"

These theorists further assumed that the decision to bias attention took place at an early stage i.e. pre-attentively and, more specifically, was independent of response

bias (p67). Thus, high trait or state anxious subjects are predicted to display a bias towards attending to stimulus events rated as high in threat value by a process of affective decision making. While acknowledging the value of the theoretical model, Eysenck (1992) commented on some of its omissions and limitations. Of relevance in the present context is the failure of Williams et al (1988) to deal with other relevant phenomena such as attentional scanning, breadth of attention and distractibility. For Eysenck (1992), these processes can be viewed collectively as a latent cognitive vulnerability factor that is termed *hypervigilance*. This is presumed to manifest itself in situations where threat is apparent to individuals with generalised anxiety disorder and high trait anxious normals. Typically they will display increased attentional scanning, more focused attention on detection of threat and generally higher levels of distractibility. These cognitive processes, operating rapidly and generally without strategic control, are involved in the maintenance of anxiety related disorders. By proposing latency in the hypervigilant tendency this model generates predictions about altered attentional processing in those who have recovered from anxiety disorders. Both hypervigilance and information processing models however propose that fear-relevant information is prioritised at an early stage for processing, implying an attentional bias. As will be seen however, the extent to which the modified Stroop reflects, solely or even partially, an acquired attentional bias is the subject of some debate.

Interpreting the Modified Stroop

The attentional bias interpretation has been challenged by some researchers, generally pointing out that colour naming latency could be a result of additional processes such as cognitive avoidance (De Ruiter & Brosschot, 1994); or a more specific response bias associated with familiarity or "expertise" (Matthews & Klug, 1993). De Ruiter & Brosschot (1994) point to the colour naming delay associated with positively valenced words as evidence of a tendency to cognitively avoid affective material in general rather than more specific schema congruent delay linked to negatively valenced words. It seems equally plausible that the positive words are in effect strongly semantically linked with their opposites e.g." happiness-sadness" and are therefore likely to disrupt colour naming possibly in a graded manner. These authors also point to the longer colour naming latencies observed with subjects with "repressor" characteristics, citing Weinberger, Schartz & Davidson (1979).

The status of the repression-sensitisation concept has been questioned by Eysenck (1992) who concluded that in essence it measured trait anxiety which means that those scoring high on the repressor scale evidenced more colour naming latency because they were more anxious. Dawkins & Furnham (1989) used a modified Stroop procedure with repressors, high trait anxiety Ss and low trait anxiety Ss. They found that colour naming latency for threat words clearly distinguished between low anxiety Ss and repressors but the difference between this group and the high trait anxious Ss was less pronounced. This is consistent with the notion that repressors are in effect dispositionally more anxious and hardly surprising given the evidence that anxious normals will take longer to colour name threatening words. It is less clear why repressors score low on measures of trait anxiety, if they are in reality simply trait anxious, apart from invoking the circular reasoning that they do so because they are

repressors. In more general terms, from an experimental cognitive perspective their is an issue of admissibility of evidence in this case: Using data gathered by self-report with its attendant biases is questionable when the problem is accounting for a more precisely specified cognitive process such as attentional bias or, as the case may be, cognitive avoidance. A more recent account of the role of self-reports in anxiety (Eysenck,1997) has emphasised the degree to which self-reports can be systematically biased in either direction (i.e. repression or verbal report of distress) resulting in discordance between subjective, behavioural and physiological indices of arousal. As these attentional and interpretative processes are not generally available to introspection they can confound attempts at classification or categorical diagnosis when the latter is based exclusively on self-report. This has important implications for both research and clinical diagnostic practice which often rely almost exclusively on self- report. It does not mean that such a key source of information should be ignored, but that where possible corroboration should be sought.

The major empirical stumbling block in accounting for the modified Stroop phenomena, and thus informing the attentional bias *versus* response bias debate is the difficulty in devising a task that cannot be influenced by strategic processes and thus prone to response biasing. As MacLeod (1991) concluded in his review, post-encoding processing was influential in accounting for some experimental findings e.g. the increased interference associated with mixing congruent colour-naming with incongruent trials due presumably to strategic switching of attention. Glaser & Glaser (1982) went some way towards specifying the temporal location of Stroop interference in a series of five experiments in which they manipulated the temporal relationship between the presentation of the colour and word components of Stroop stimuli. They demonstrated that pre-exposure of word or colour patches up to 400 msecs prior to the other component (i.e.colour or word stimulus respectively) did not impact on reading but strongly inhibited colour naming when the stimulus onset asynchrony (SOA) procedure used incongruent colours. They concluded that these data were inconsistent with a relative speed of processing account of Stroop interference which would predict the temporal advantage of advance colour presentation would cancel out the facilitation inherent in reading. Conceptually this has important implications, pointing to Stroop interference being located early in the information processing cycle and therefore not solely or even predominantly reflective of response bias.

Returning to the modified Stroop, of relevance also is the finding that Stroop response latency is not necessarily linear in proportion to the threat value of the stimulus: contrary to predictions, Mathews & Sebastion (1993) found a *facilitation* of colour naming when snake phobic subjects were required to perform in the presence of a real snake. Their subjects were not drawn from a clinic population however, which raises questions about the interpretation of these findings. Moreover, as was seen above, Stroop interference has been reported with diverse client groups such as those with eating disorders where the emotional valence is more ambiguous and hence a motive for avoidance is less clear.

Phenomonenologically at least, the experience of people afflicted by chronic anxiety is that, far from *avoiding* emotional memories and other cognitions, their intrusive

nature makes them unwelcome as does their resistance to voluntary dismissal or distraction. The possibility that these cognitions are generally subject to attenuated cognitive processing has been explored as an explanation of colour naming delay with PTSD Ss. This is proposed as an explanation of the apparent paradox between the existence of cognitive avoidance in the face of what is often preoccupation with the source of threat. Thrasher et al (1994), for instance, speculated that the increased colour naming delay in more symptomatic Ss could be due to the increased effort required to inhibit the reading response in the face of re-activated traumatic memories. This contrasts with the reaction of the less affected PTSD Ss who had presumably processed the traumatic memories more completely, thus reducing their potential for distraction.

Even if the modified Stroop had never been devised, accounting for the large and growing literature on the original, colour-conflict Stroop has proved a challenge to psychological theorists. Given the scope of the empirical database however more integrative reviews have been published. In the most recent, comprehensive, review, MacLeod (1991) attempted to integrate the findings of over 700 studies of the Stroop effect then available. MacLeod (1991) found the conceptually close speed of processing and automaticity accounts of the Stroop phenomenon wanting in the light of empirical findings and endorsed a parallel distributed processing (PDP) theoretical account described by Cohen et al (1990) as a framework for future research. As the modified Stroop has not yet faced the empirical challenge reviewed by MacLeod (1991), the degree to which it fits into a PDP framework remains unclear. Further, the extent to which it reflects response competition, assumed to be influential in the original Stroop, is open to question (see Eysenck, 1992, p64). Both versions of the Stroop appear to measure *interference* with one task (colour naming) by another (the words that are 'colour-named') whether these are incongruent colourwise or emotionally valenced. In both versions the over learned tendency to read words competes with the experimental instructional set. In the modified Stroop, this interference is assumed to reflect the threat value or degree of activation of cognitive structures associated with emotionality.

In their paper quoted above, Cohen et al (1990) proposed a model based on the principles of parallel distributed processing (PDP) which proposes that both speed of processing and interference are related to an underlying variable labelled *strength of processing*. This construct, these authors propose, can account for three attributes of automaticity: practice effects, response competition and attentional regulation. In terms of Stroop interference, the higher levels of speed and accuracy normally apparent on the reading task lead to suppressed performance with the colour naming task because both tasks share common, differentially activated, pathways which interact. The definitive feature of the PDP model is therefore its accounting of attention which is modelled as a *modulator* of processing in the hypothetical network pathways. This is achieved through alteration of the responsiveness of the units implicated in responding to task demands (e.g. "respond to colour" or "respond to word") and thus the resulting pattern of interference or facilitation characteristic of the colour-conflict Stroop. The implication here is that all processing in the network is affected by attention to some degree as evidenced by the interference caused by word reading, a task definitively automatic or "direct". A corollary to this is that there is a continuum of automaticity. (see Fig. 2)

PDP Model of Stroop Interference
Cohen et al (1990, P.336)

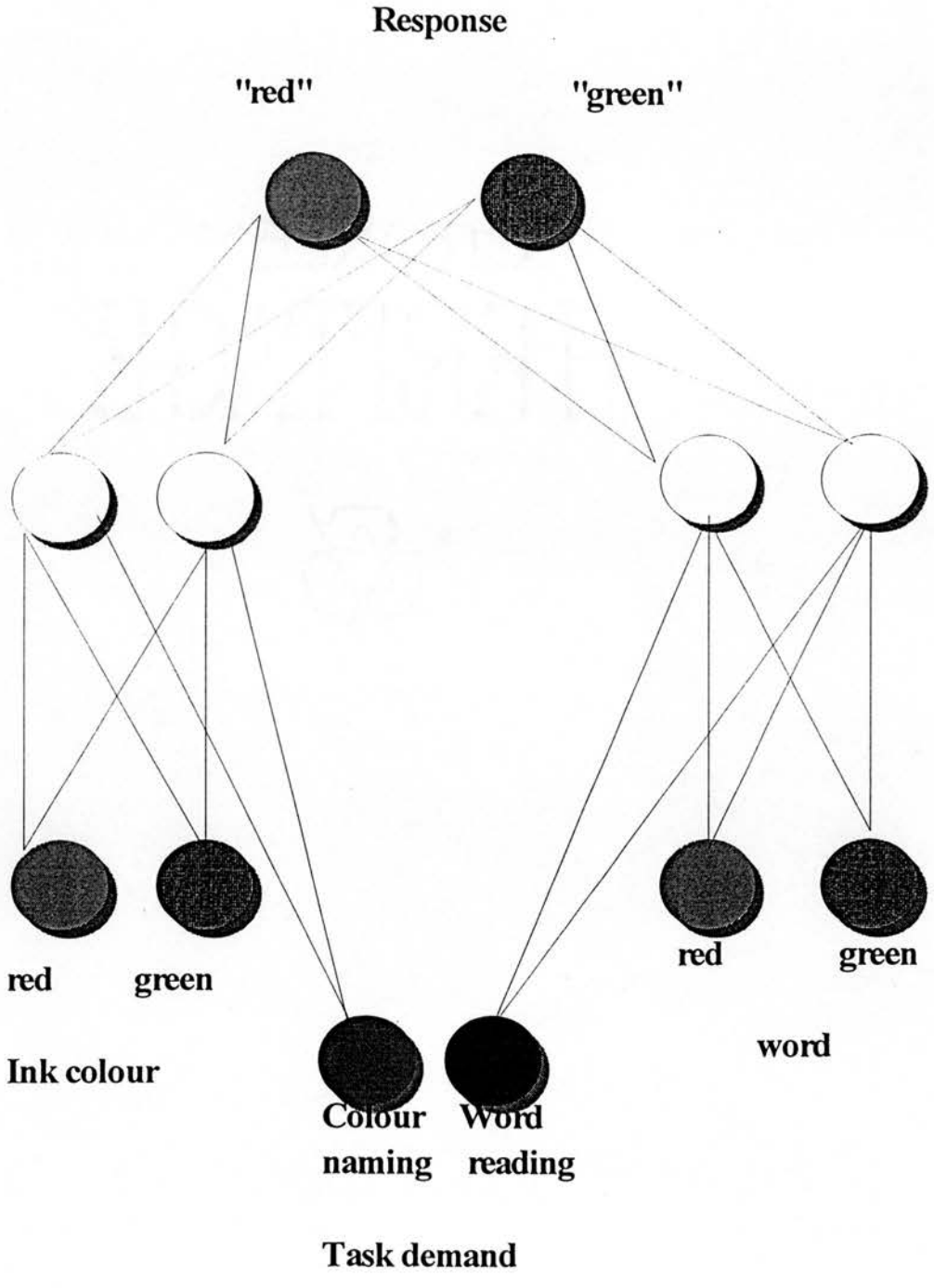


Figure 2 A Parallel Distributed Processing model of Stroop Interference (Cohen et al 1990))

The notion of an attribute such as strength of processing that is continuous and sensitive to environmental events such as the number of practice trials provides a convenient stepping stone to the clinical domain. The fact that a wide spectrum of psychological disorders are characterised by repetition and persistence of problematic thoughts, behaviours and emotions raises the possibility that strength of processing is an important feature of these syndromes. A particularly apt example is that of addictive behaviour, which in connectionist terms could be viewed as regulated by cognitive processes relatively high in strength due to repeated activation of pathways. In the absence of consensus in accounting for the processes mediating the emotional Stroop effect, it can nonetheless be concluded that there is evidence of the disruptive influence of emotionally valenced words on colour naming. The evidence suggests that this is reflective of the emotional and personal concerns of the individual in a specific and probably quantifiable manner. Applying Cohen et al's (1990) account to the emotional Stroop, the key point is that the processing that occurs under significantly reduced attention, is enough to delay, but not dominant enough to subvert, the colour-naming task demand. Moving to the clinical arena, Stroop latency has been found to relate meaningfully to other indices of distress or dysfunction, and, more tentatively, to therapeutic gain. The fact that the colour naming task does not require introspection or self -report, with their attendant pitfalls, adds to the potential of the modified Stroop paradigm as a means of charting the cognitive substrate of emotional disorder.

IMPLICATIONS FOR ADDICTIVE BEHAVIOUR

In accounting for addictive behaviour theoretical models derived from classical conditioning theory and social learning theory represent established conceptual frameworks with strong empirical bases. As will become clear however these approaches have not generally guided researchers towards cognitivist models. Both behaviourist and cognitivist traditions have sought to account for cue exposure and cue reactivity according to their own imperatives but both implicitly regard the cue as a "given". The most comprehensive published account of cognitive processing in drug urge and drug-use behaviour is provided by Tiffany (1990,1992) and discussed above. As will be recalled, he outlined a dual processing framework, which described the drug acquisition and consumption procedures as automatised in the following terms: "stereotyped, stimulus-bound, effortless, difficult to control and not dependent on awareness for completion" (Tiffany, 1992 p.132.) Tiffany further described how urges to engage in drug use are generated only when either gratification is denied through environmental impediments or when conscious, effortful attempts are being made by an abstinent person to avoid drug use. Conceptually this is at a different level from much of the foregoing such as PDP models. It is concerned more with the control of action rather than cognitive processes *per se* and draws on the work of Norman & Shallice (1985). These authors specify the overcoming of habitual responses or resisting temptation as examples of situations where deliberate attentional processing is essential, thus supporting the key proposition of Tiffany's model that urge responding is governed by non-automatic processes.

This model correctly highlights the role of non-conscious, automatised processing in the regulation of drug use but perhaps at the cost of minimising the role of consciously planned routines. The implicit assumption seems to be that drug acquisition is, in the cognitive processing sense, effortless (in Tiffany's example the alcoholic only has to deploy non-automatic processes when it emerges that the refrigerator is bereft of alcohol because drug seeking is regulated by automatised processes). The environment is rarely so munificent to drug users however and often requires a high degree of cognitive effort before gratification is forthcoming. The point at issue here is the extent to which automatic routines are influential in the cycle of drug acquisition and consumption. As Jacoby et al (1993) point out, consciously controlled processes *set the context* for such automatised processes but essentially automaticity is an "emergent property" of the execution of particular skilled behaviours in an environment rather than being purely stimulus bound. In support of this Jacoby et al (1993) report some of their efforts at developing experimental procedures for dissociating the relative contribution of automatic and strategic processing in cognitive tasks such as memory. This process-dissociation paradigm has not been applied to research in the emotional disorders but evidence points towards a fluctuating contribution of automaticity in memory. Jacoby, Woloshyn and Kelley (1989) demonstrated this variability by means of a divided attention procedure. When subjects were distracted by a competing task more errors due to automatic processing were made.

It could be argued that insofar as the modified Stroop procedure provides an example of divided attention it dissociates the strategic from the automatic processes although the experimenters do not control the allocation of attentional resources as directly as in the process dissociation paradigm (Jacoby et al, 1993). Nonetheless, from this perspective, colour-naming latency is at least an index of attentional resource allocation and as such should reflect the relative contribution of task irrelevant automatic processing to the performance. The most important characteristic frequently attributed to automatic processing is the degree of voluntary control exercised. In the modified Stroop paradigm the delay with emotionally valenced words is consistent with involuntary processing as subjects appear compromised in their ability to perform the colour-naming task when specifically relevant word stimuli are featured. Generalising this to real person-environment interactions justifies the emphasis Tiffany (1992) placed on the role of automatic cognitive processes. The possibility that, at critical junctures in the process of changing patterns of addictive behaviour, regulation might be governed by stimulus-bound, stereotyped, rapid processes occurring outside awareness is of considerable theoretical and clinical import. This comes close to one of the other key attributes of automaticity that Norman & Shallice (1986) specify, namely the "attention-demanding" feature of the stimulus.

To conclude, viewed in this more circumscribed, operationally defined context, the modified Stroop is an appropriate research tool with which to probe automaticity. The broader question of whether automaticity is conceived of as a fully independent regulatory system operating for the most part outside conscious control or is more context bound with the parameters set by conscious operations is a question yet to be fully addressed empirically and lies beyond the scope of the present study and the limitations inherent in the modified Stroop paradigm.

EMPIRICAL EVIDENCE

The most direct empirical evidence of selective processing of information takes place in the context of addictive behaviour comes from the research of Gross, Jarvik & Rosenblatt (1993). These investigators recruited 20 smokers and randomly assigned them to either nicotine abstinence or continued normal smoking for a period of 12 hours. They found that, as predicted, abstinent smokers (N=10) showed significant colour-naming latency on a card-format Stroop procedure consisting of smoking related and frequency-matched neutral words. In contrast, the non-abstinent group (N=10), who had presumably carried on smoking at their normal rate, showed the reverse effect i.e. faster colour-naming of smoking - relevant words compared to neutral words matched for frequency. The authors speculated that this could be due to non-abstinent smokers benefiting from greater processing efficiency when colour-naming smoking words when compared to neutral words as the former would possess a greater functional frequency regardless of attempts at frequency matching. The facilitation is consistent with the operation of rapid, relatively autonomous, processing. Gross et al (1993) however acknowledge the possibility of problems with the matching of words across the two stimulus conditions on the basis of population norms. This led to some apparently incongruous choices in the control word condition such as "glycerin", "pennant" and "saddlebag" which while presumably correctly matched for frequency to smoking words seem somewhat arcane.

A potentially more difficult problem with this aspect of the study is the failure to select a list of neutral words from a semantically homogenous category as the smoking stimuli were necessarily semantically related. There was therefore a semantic priming effect with the smoking words but not with the neutral words. This means that the predicted longer colour-naming latency for smoking related words in the abstinent condition could have been influenced by the effect of the semantic homogeneity of these words which made the colour-naming task more difficult. Abstinent smokers could thus have been more susceptible to interference based on priming effects than their smoking counterparts. As will be seen in the following section, abstinent addicts are particularly sensitive to disrupted information processing. Gross et al have demonstrated this but leave some uncertainty regarding the extent to which the interference was due to comparing colour-naming of high-frequency, semantically linked words to that of low- frequency, unrelated words. Nonetheless, a design that manipulated the drug-using status of Ss and demonstrated between- subjects effects is noteworthy and worth replicating.

Corroborative, if less direct, evidence comes from studies that assessed the impact of naturally occurring or experimentally manipulated urges to engage in forms of drug taking on cognitive efficiency on unrelated tasks such as responding to tone probes or other reaction time tasks (Droungas et al, 1992; Cepado-Benito & Tiffany, 1994). Relating this to clinical outcomes, Drummond, Tiffany, Glautier and Remington (1995) cite a study by Binkoff et al (1984) which found that alcoholics who were more reactive to alcohol cues manifested more coping skill deficits when exposed to salient cues than their less reactive counterparts. This might appear somewhat obvious

depending on how cue reactivity is defined (from a cognitive processing perspective it could be regarded as attending to task irrelevant stimuli), but nonetheless highlights the potential sensitivity of post-treatment alcoholics to salient cues. This disruption in cognitive processing is also consistent with the clinical anecdote described above. However, it should be recalled that almost a third of clinic alcoholics in some studies failed to display any reportable subjective or measurable physiological response to relevant cues. In the absence of a direct measure of attentional focus, apart from the somewhat circular that those who responded attended to the cue and that those who failed to respond did not, the inconsistent research findings hypothetically implicate a cognitively mediated differential response.

Another source of variability that needs to be taken into account is habituation, which in the context of the emotional Stroop can be reflected in faster colour naming times either across trial blocks (within session) or over longer periods (between session) when therapeutic intervention, for instance, is involved. Green, McKenna and De Silva (1994) pointed out that while some evidence exists on the sensitivity of Stroop interference in response to treatment (e.g. Watts et al 1986), very few researchers have measured intra-session habituation to Stroop interference. In their own investigation Green et al (1994) found evidence of speeding up of colour naming times for body-shape words compared to food related words and neutral words. This was interpreted as an indication of the relatively robust nature of the attentional shift towards food related words and was regarded as consistent with observations and self-reports pointing to the pre-occupation with food that eating disordered individuals display. The available literature in the addictive behaviour field does not allow for such specific predictions to be made. In the absence of any evidence of Stroop interference with any alcohol related words it therefore appears premature to speculate on the durability of any putative effect. A starting point however is to assume a habituation effect which has been defined as " the decline in response to a repeatedly presented stimulus" (Mackintosh, 1987).

THE PRESENT STUDY

At the inception of the present study only one investigation using Stroop methodology in addictions was available (Gross et al, 1992). In the absence of a significant body of empirical findings the predictions tested in the present study are necessarily exploratory and inferential. The lack of empirical data on the role of cognitive processes in addiction and cue exposure research discussed above is therefore also apparent in the literature on social learning theory applications. Theorists have nonetheless invoked cognitive factors such as efficacy and outcome expectancies in their efforts to account for the modification of addictive behaviour. As discussed earlier in this text, these efforts have focused explicitly on strategic or controlled processes such as planning ahead and learning new coping or problem solving strategies. Marlatt (1985) for example uses the metaphor of a motorist to represent the post-treatment progress of the addict. He proposed that "high risk situations" (i.e. for re-occurrence of the voluntarily proscribed addictive behaviour) could be represented

metaphorically as a car journey with all of the attendant hazards such as hairpin bends. The dangers are however preceded by warning signs and the goal of therapy is to teach the client to identify these with the aim of employing the appropriate coping responses. The worthy therapeutic goals of increased vigilance and enhanced coping imply, and indeed rely on , changes in cognitive processing . As a review of the outcome research will testify, this process of anticipation and timely coping is occasionally or probably frequently unsuccessful (Lindstrom, 1992). Further, the task of detecting and allocating processing resources to stimuli predictive of either metaphorical or real hazards in the context of relapse prevention has not been directly investigated to date. A starting point is to directly investigate aspects of selective cognitive processing of individuals with clinically significant substance misuse problems including dependency. This is in essence the rationale of the present investigation.

In the present study, a modified Stroop procedure was devised to address a twofold research problem: The first concerns itself with the question of whether the performance of a clinic sample of problem drinkers is distinguishable from non-patient controls; the second focuses on the relationship between Stroop performance and indices of alcohol consumption and alcohol problems. More general factors such as "caseness" (Martin ,Williams & Clark, 1991) might also be involved. Essentially, these researchers found that Stroop interference did not discriminate between groups of normals displaying different levels of trait anxiety. Eysenck (1992) concluded in his review that there was nonetheless convincing evidence that high trait anxious normals were susceptible to Stroop interference with threatening stimuli. Given the lack of similar studies with addicted populations, the predictions in the present study are based on conceptualisations of automaticity such as those discussed above (pp19-20). Regarding subject selection it was clear that the clinic sample required would need to be drawn from a population with manifest alcohol problems but currently abstinent and actively engaged in resisting any reversal of this state of sobriety. Apart from eliminating the disruptive effects of current or very recent heavy drinking on information processing, a dependent measure in the study, ensuring abstinence allowed for an information-processing framework to be applied. Specifically, by looking at a cohort of Ss that were, in the words of Norman & Shallice (1985,p2.), attempting to overcome a "strong habitual response or resisting temptation" provides a context in which competition between controlled and automatic processing is likely to be accentuated and thus reflected in Stroop interference with salient stimuli.

The control group was selected with a view to matching the experimental group for frequency of usage and familiarity with the word stimuli used in the Stroop task (see below). More conventional control procedures such as word frequency matching were not employed due to the assumed high frequency of usage of the alcohol-related terms in *both* groups. The rationale for this decision was to provide the most stringent test of a processing bias implicated in alcohol addiction while prioritising attempts at controlling for familiarity or frequency effects, attributes assumed to impact on the output of the control Ss also. Put simply, this enabled observed differences in colour naming between the groups to be attributed more confidently to clinical status once general cognitive impairment due to alcohol ingestion or other factors had been accounted for. Inevitably, matching on this criterion compromised efforts to equate

the two groups on other important dimensions such as age. Another important issue is the fact that the control group was likely to be regular or occasional consumers of alcohol, in keeping with general population norms. In relation to this characteristic it should be borne in mind that the predicted differences in Stroop performance across groups described next were predicated on disordered alcohol use rather than regular consumption *per se.* The extent to which such drinking behaviour was habitual and hence relatively automatised provided a conceptual basis for hypotheses regarding the relationship between indices of this behaviour and the relatively automatised diversion of cognitive processing resources characteristic of the modified Stroop procedure.

HYPOTHESES

It is **firstly** hypothesised that the alcoholic cohort will display a pattern of performance on a modified Stroop test consistent with a preferential processing bias towards words related to alcohol misuse compared to neutral words. This is derived from the substantial body of evidence pointing to the existence of selective processing of emotionally salient words among clinic populations, generally indexed by colour naming latency on modified Stroop procedures.

Secondly it is predicted that significant positive relationships will emerge between the measure of cognitive processing on the one hand and indices of severity of alcohol dependence and parameters of alcohol consumption on the other. This is predicated on the habitual, repetitive nature of addictive behaviours and the assumption that these will be regulated by relatively automatised cognitive processes and thus sensitive to Stroop interference. These processes have been conceptualised as *strength of processing* (Cohen et al, 1990, see pp 19-20 above). Tiffany (1990, p.162) predicted that indices of automatisation should be strongly related to the extent of practice or chronicity apparent in the drug history. Insofar as controls will also have engaged in recent and possibly regular alcohol consumption it is assumed that the relationship between the index of cognitive processing and aspects of drinking behaviour will still hold although to a lesser degree. This reflects a conceptual view of alcohol use that is dimensional rather than categorical.

Thirdly it is hypothesised that habituation, as reflected in speeding up of colour naming across the two trials, will be significantly greater with the clinic sample with respect to the clinically relevant words and compared to the performance of controls. This prediction is derived from the results of Green et al (1994) who found that their eating disordered Ss showed different patterns of habituation to food and body shape words which were interpreted as showing a more robust cognitive processing bias (i.e. less habituation) towards the former. In the absence of any direct evidence the present hypothesis is the more conservative one based on the general tendency for individuals to show a decline in response to repeatedly presented stimuli, especially when the stimuli are emotive.

METHOD

Overview

A group of 33 problem drinkers attending a specialist clinic and 32 control healthcare staff performed a modified Stroop colour naming task using two sets of stimuli printed on different cards. The Ss were required to colour name alcohol related and neutral words with response latency designated as the dependent measure. Other variables relating to alcohol history and emotional functioning were also specified.

Sample

Subjects (Ss) for the experimental (clinic sample) group were recruited in cohorts of successive attendees to a community based treatment centre for alcohol problems between July 1994 and August 1995. Controls were recruited between November 1994 and March 1996. Ss were predominantly male with the gender balance equivalent across groups with four and five female Ss in clinical and control groups respectively.

The following **inclusion criteria** were applied for recruitment into the clinic cohort: -
A history of alcohol problems of at least five years duration and/or a diagnosis of Alcohol Dependence Syndrome (ICD/DSM)

- Scores of at least 31 on the 20-item Severity of Alcohol Dependence Questionnaire (SADQ). This is the threshold specified by the authors for classifying alcohol dependence as "severe". (Stockwell, Murphy & Hodgson, 1983).

Exclusion criteria were as follows:
- Indications of alcohol use prior to participation in the study.
- Concurrent use of psychotropic medication or illicit drugs.
- Evidence of gross neuro-cognitive impairment (apart from the general loss of cognitive efficiency associated with recent alcohol excess and withdrawal from same).
- Evidence of significant mental health problems (apart from the dysphoria and anxiety associated with withdrawal from alcohol).
- Colour blindness or other significant visual impairment
-Ss for whom English was not their first language.

Control Subjects

These were volunteers recruited from Riverside Substance Misuse Service and were predominantly from health and social care backgrounds. A subset was recruited from a diploma course in addictive behaviours. These Ss were also specialising in this area and worked in direct clinical roles or related settings such as supported housing.

See Table 1 for a description of relevant variables in the two groups.

Table 1. Characteristics of Clinic and Control Subjects

	Clinic (n=33)	Control (n=32)
Age (years)	**43.12(9.49)**	**36.94(8.35)**
Years in full time education	**15.03(2.71)**	**15.38(3.45)**
Severity of Alcohol Dependence Questionnaire Score	**35.39(10.71)**	**2.34(3.92)**
Average quantity of alcohol per drinking occasion (standard units)	**27.06(13.38)**	**5.84(3.73)**
Duration of habitual drinking (years)	**17.58(12.05)**	**15.22(9.60)**
Anxiety Score (H.A.D)	**11.33(3.89)**	**5.03(2.86)**
Depression Score(H.A.D.)	**15.22(9.60)**	**8.06(5.42)**
Time elapsed since last drink (hours)	**101.12(169.11)**	**40.91(774.12)**

Standard deviations in brackets

Subjects in the clinic sample were significantly older than those in the control group, as can be seen from Table 1. Both groups were equivalent in terms of years spent in full-time education, here assumed to index general intelligence. All Ss scored within the expected range in keeping with their clinical or control status on measures such as the HAD and SADQ. Similarly, as can be seen from the data on alcohol consumption, the groups can be clearly distinguished in terms of quantity of alcohol consumed per drinking occasion. The clinical cohort can therefore be characterised as significantly alcohol dependent, anxious and depressed when compared to the control group. The clinic group also reported a *longer* period had elapsed since last consuming alcohol when compared to their counterparts in the control group. This reflected the fact that Ss in the former group were attempting to abstain. Statistical analyses of the mean differences are in Appendix I.

Design

A 2x2 mixed design was employed with clinical status of subject (problem drinker or control) and word type (alcohol related or neutral) as factors. The dependent measure was colour-naming latency using a modified Stroop task consisting of words related to alcohol and alcoholism and neutral, semantically homogenous control words.

Materials

Stimulus Words

The experimental words were selected from a list of terms judged to be frequently used by clients. This original list was formed by a "brainstorming" procedure conducted by the experimenter (E) with three colleagues. This exercise generated 22 words (see Appendix II). In the absence of any objective or quantitative means of selecting words, the list of words to be colour-named was compiled on the basis of ratings by clinic attendees. These clients (N=10) were asked to rate the terms according to subjective threat or desirability on a four-point scale. The aim was to generate terms that would have emotional connotations with the clinic sample, who were not recruited from these volunteers. The selected words consisted of the following:

ALCOHOL, ADDICTION, DEPENDENCE, DRUNK, RELAPSE.

The above list were words that were rated as "unpleasant or threatening" (mean rating 1.225) rather than "desirable" (mean rating 0.833), although, as can be seen, there is some overlap. The mean ratings suggested that the words chosen for inclusion were emotionally salient in terms of threat value but could also be rated as desirable. Of note was the general failure to rate names of alcoholic beverages on either dimension. The final list reflected to some degree inputs from individuals representative of both clinic and control samples, none of whom participated subsequently.

Control words were selected from a category that was presumed to be semantically homogenous as follows:

FIREPLACE, CHAIR, BATHROOM, KITCHEN, CUPBOARD.

Apart from selecting terms that were mundane and presumably in common usage these words were not matched for frequency with the "alcohol" set because this would have been of questionable validity due to the assumed high frequency of usage of the latter by the participants. Words were matched for number of letters ("alcohol" words contained 38 letters and neutral words contained 37). Both groups of words were printed in colours generated by a suitable computer programme and matched as closely as possible to RED, GREEN, BLUE and BROWN. The words for each condition were then printed on cards in letters measuring 4 millimetres by 3 millimetres. Words appeared in a pseudo-random order with the proviso that the same word or colour did not immediately follow (see Appendix III). Each of the words

occurred ten times in each condition, assigned to each of the four colours on a random basis.

The Severity of Alcohol Dependence Questionnaire (S.A.D.Q.). The SADQ (Stockwell et al 1979) is a 20 item self-administered questionnaire. The original, slightly longer, version was originally standardised on a sample of 104, predominantly male, clients at a London clinic specialising in treating addictive disorders. Factor analysis on data gathered from this sample suggested that one factor accounted for 53% of the total variance. Further analysis pointed to the large and significant contribution made by physical and affective withdrawal symptoms as well as the rapidity with which these were reinstated when alcohol was again consumed after periods of abstinence. The SADQ is routinely administered to RSMS clients.

The Hospital Anxiety and Depression Scale (HADS) (Zigmund & Snaith, 1983). The HADS is a 14-item questionnaire which was designed to detect clinically significant levels of anxiety and depression among general hospital out-patients. It provides separate measures for both anxiety and depression and an indication of the severity. The HADS was standardised on a sample of 100 and has acceptable validity. It has the advantage of brevity and ease of administration and also forms a part of the routine assessment for RSMS clients.

Sociodemographic Data. These data were gathered through a brief self-administered questionnaire. Ss were also asked how many years they had spent in formal education, the response to which was used as a means of comparing groups in terms of intellectual ability.

Alcohol Consumption Variables. In addition to measuring dependence using the SADQ, Ss were also interviewed about their patterns of past and more recent alcohol consumption. The guidelines for this were based on the *Quantity-Frequency-Variability (QFV)* index (Cahalan, Cisin & Crossley, 1969). These parameters capture important features of alcohol consumption and will be independent variables in subsequent data analyses. Related to this, these indices are quantifiable along a continuum along which both experimental group Ss and control group Ss can be placed. This is in contrast to the SADQ score which, in addition to quantifying the degree of alcohol dependence, has a cut-off point and was also used as a means of screening Ss. Thus any potential control group volunteer who scored in the clinical range on the SADQ could be excluded and conversely any recruit for the clinic group who scored below this would also have been excluded. Neither eventuality occurred.

Procedure

Prior to participation in the test sessions all Ss were presented with a consent form to read and sign if the subject was prepared to continue (see Appendix IV for this and the *post hoc* explanation). This explained that the task would involve identifying colours and answering a series of other questions on a strictly confidential basis. If it was not already known, Ss were asked whether (a) they were aware of any colour vision problems and (b) whether English was their first language. The S was then invited to a

well- lit consulting room towards the rear of the clinic where all testing subsequently took place. The session began with the Stroop procedure. Firstly Ss were given a column of words to colour name from the original Stroop test (Trenberry, Crosson, DeBoe & Leber, 1989). This was carried out as a practice trial but also allowed the experimenter (E) to verify the self-reported absence of impairment in colour vision or other impediments to performing the modified Stroop task. The *Modified Stroop* test was administered next with "alcohol" and "neutral" words presented in a counter-balanced order. Ss 1-5 completed two trials of the alcohol Stroop and one of the neutral words. Subsequently, the procedure was modified and the remainder of the Ss carried out two trials in each condition. This *post hoc* adaptation of the procedure was instigated in order to provide a more definitive test of predictions regarding the relative durability of Stroop interference (hypothesis three relating to habituation) across conditions in keeping with the factorial design. Thus, in addition to comparing putative changes in response times to "alcohol" words across groups the additional trial with neutral words enabled comparisons across conditions to be made within groups. In all cases half of the sample began with the neutral Stroop and half started with the alcohol version. Responses were timed using a digital stopwatch. Responses were also initially recorded on audio tape in order to monitor errors but this was discontinued after S five as it proved possible to monitor the very low error rate without any difficulty. Following the completion of the modified Stroop test Ss were interviewed about aspects of their alcohol consumption and completed the necessary questionnaires. Finally Ss were given the explanation sheet (Appendix IV) and invited to ask questions if necessary.

RESULTS

Following the completion of scoring and collation of the various measures the data were analysed using SPSS for Windows. Means for the dependent measure, colour naming response time, are shown in Table 2.

Table 2. Mean Colour Naming Latency in Both Conditions and Trials (Seconds)

		Clinic	Control
Alcohol word	**Trial 1**	**48.01(13.13)**	**39.61(7.76)**
	Trial 2	**41.67(10.00)**	**37.67(7.89)**
Neutral word	**Trial 1**	**41.72(11.28)**	**36.12(8.27)**
	Trial 2	**37.67(8.25)**	**34.31(7.8)**

Standard deviations in brackets

Analysis of variance (ANOVA) was used to test the significance of any differences or interactions among the mean response times. This revealed main effects for Group [F (1,63)=5.82, P<0.05]; Trial [F (1,64)=39.99, P<0.001]; and Word [F (1,63)=62.29, P< 0.001]. These analyses were consistent with the trends notable in Table 2, indicating faster response times for colour naming (i) across both conditions by the control group, (ii) on the second of the two trials and (iii) colour naming the neutral words compared to the alcohol words. The hypothesised interaction between Group and Word failed to reach significance [F(1,63)= 2.77, P>.05]. These analyses were completed assuming a full dataset by substituting the relevant mean for the missing values. As described above, these missing values were for the second trial of the neutral version of the modified Stroop procedure for Ss 1-5 inclusive. Subsequently, the ANOVA was repeated without the cases containing the missing values. This revealed similar findings to the procedure carried using the substitution procedure[F(1,58)=2.42, P>.05]. Both versions of the ANOVA are in Appendix I.

A further consideration relates to the appropriateness of ANOVA procedures given the differing variances in the dependant measure across groups. Levene's test of equality of means revealed significant differences in variance for mean colour naming latency in both conditions across experimental and control groups [F=6.789, P<.05 for neutral words; F=6.089, P<.05 for alcohol words, df=63 in both cases]. Taking advice from Howell (1997) however, there are situations where the assumptions of homogeneity of variance and normality can be relaxed with relatively little cost to the validity of the procedure. This assumes that the sample sizes are approximately similar in each group and that the variances do not differ by more than a factor of four from the smallest to the largest (Howell, 1997, p.327). The present data meet these requirements .

In order to describe the performance of each group with respect to word type an "interference index" was derived by calculating the difference in response times for each group in each condition (i.e. colour naming alcohol or neutral words). This compound variable allowed for direct comparison between groups despite the less efficient cognitive processing by the alcoholic group associated with the deleterious effects of alcohol excess and their greater age. The mean scores in seconds are shown in Figure 3

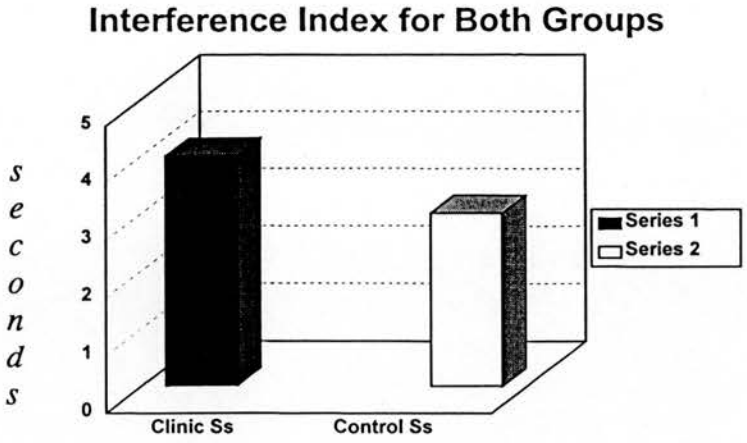


Figure 3

Following the example of Williams, Mathews & MacLeod (1996) the mean time difference was also calculated for each word by dividing the "interference index" described above by the number of words that were colour named across both trials. The results indicated that the time difference between colour naming alcohol words and neutral words for the clinical group was 102 milliseconds compared to 70 milliseconds for the control group. This transformation of the data allows for at least an approximate comparison to be made with results from other research studies where procedural differences might otherwise prevent this. The data are consistent with a trend for the clinic sample to evidence more interference with the alcohol related words.

Multiple Regression Analyses were conducted to evaluate the relationships hypothesised between alcohol consumption variables and Stroop performance in keeping with the hypotheses stating that chronicity and severity of alcohol misuse would be predictive of increased disruption to colour naming. A series of stepwise regression equations was calculated using a range of alcohol consumption indices as independent variables and the derived interference index as the dependent variable. Variables such as depression, anxiety, group status (experimental or control), age and education were also included but failed to reach significance and were dropped from subsequent analyses. The independent variables that were most predictive of alcohol-specific Stroop interference were SADQ scores, quantity of alcohol consumed in a typical drinking occasion (QPO), and the duration of either problem drinking or the regular social drinking in the case of the control group. This equation is shown in Table 3 and was significant [F (3,61)=4.07, P<.01]. An unpredicted finding was the negative relationship observed between QPO and the dependent variable.

Table 3. Multiple Regression Equation Most Predictive of Stroop Interference

Variable	Beta	T	SigT
Duration	. 264	2.27	. 0263
QPO	. 416	2.14	. 0365
SADQ	. 531	2.718	. 0085

Multiple R	. 439
R.Square	. 193
Adjusted R Square	. 153
Standard Error	4.066
Analysis of Variance	F=4.857
Significance=	.0043

Variable entered on step number

1. **Duration of habitual or problem drinking in years**
2. **QPO(quantity of alcohol typically consumed per drinking episode)**
3. **SADQ(severity of alcohol dependence questionnaire score)**

N=65 Df 3,61

The third hypothesis predicted that the experimental group would evidence less habituation to colour naming alcohol words relative to control Ss and in comparison to neutral words. ANOVA revealed that the hypothesised interaction between word category, clinical status of subject and trial block was not significant [$F(1,63)=.773$ $P>.05$]. Again, taking account of the missing data for Ss 1-5 the analyses were repeated without these cases with a similar null finding [$F(1,58)=1.258$)$P>.05$] Performance across both conditions and trials improved as evidenced by the main effect of reduced colour naming latencies for all Ss (see fig. 4).

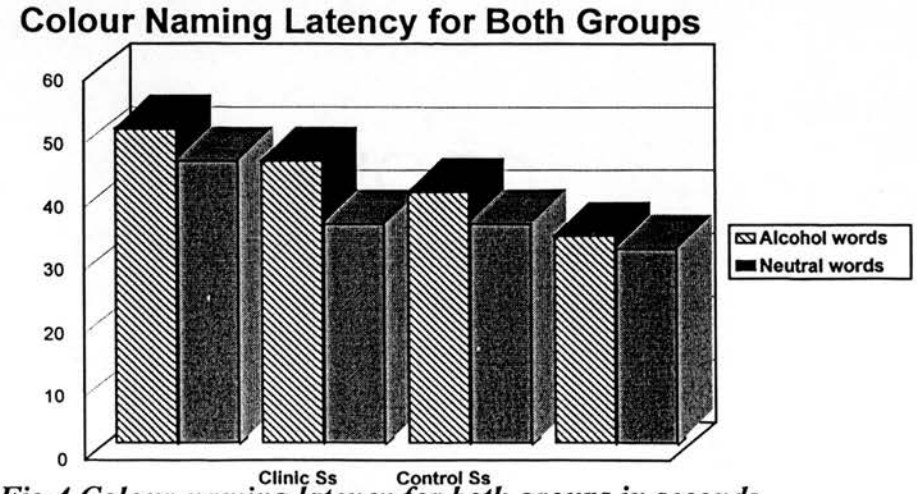


Fig.4 Colour-naming latency for both groups in seconds

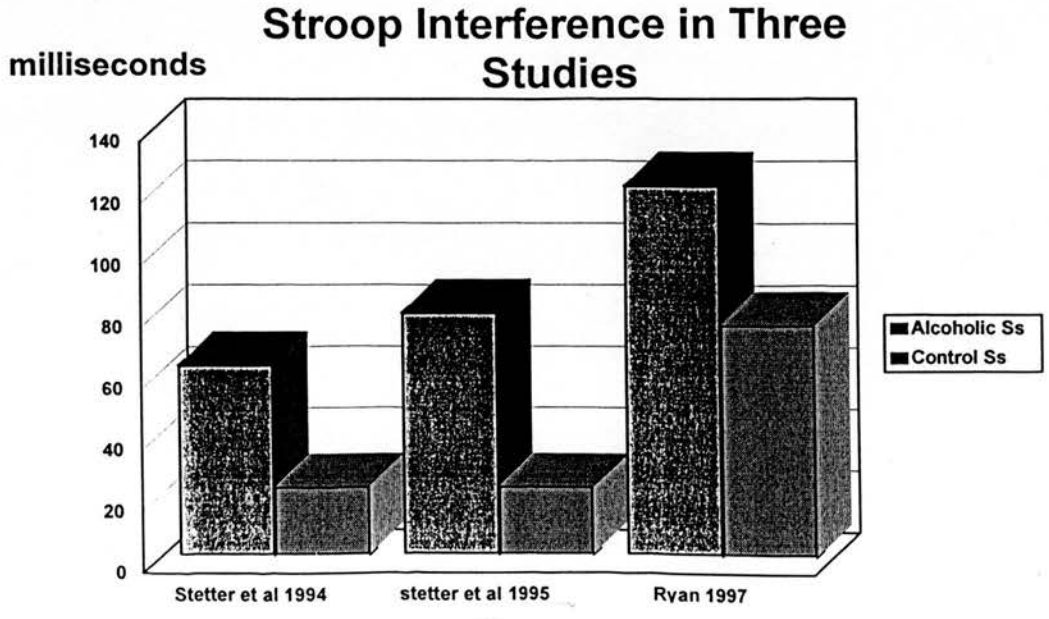
DISCUSSION

The current study investigated the possibility of selective cognitive processing in the context of addictive use of alcohol. The problem addressed was twofold. The first issue was to establish whether or not a cohort of problem drinkers in treatment would display attentional bias congruent with their clinical status. Following on from this, it was proposed to explore the relationship between any putative interference and behavioural and psychometric indices of alcoholism. A subsidiary hypothesis related to the role of habituation in the emotional Stroop task.

In relation to the primary hypothesis concerning content-specific Stroop interference, the results reported are not supportive. The predicted interactions did not attain significance but the observed data showed a trend towards increased colour naming latency consistent with a processing bias. The recent review of the emotional Stroop task by Williams et al (1996) enables some tentative comparisons to be made with the present results. The times 102 and 70 milliseconds (ms) obtained for the experimental and control groups respectively straddle the grand mean of 84 ms computed by Williams and his colleagues from the subset of the studies using card based presentation.

A more direct comparison can be made by comparing the interference indices obtained by Stetter et al (1994) and Stetter et al (1995) which were 62 ms and 22ms in the first study and 77ms and 23ms in the second for alcoholics and controls respectively (see figure 5). The salient point here is that the alcoholics in the present study demonstrated more interference than their counterparts in the two samples recruited by Stetter et al but the controls in the present study also evidenced very robust Stroop interference with alcohol words. In fact the interference scores obtained by the controls in the present study are neatly bracketed by those reported by Stetter and co-workers for their alcoholic groups, differing by an average of less than eight milliseconds.

Figure 5



Clearer and more consistent predicted results emerged from the regression analyses, with one notable exception. Here, it will be recalled, a series of predictions were made stating that indices of the severity and chronicity of alcohol consumption would be predictive of cognitive processing bias as measured by the modified Stroop task. The findings were that the quantity of alcohol typically consumed per occasion (QPO), the duration of problematic or habitual drinking and psychometrically determined severity of alcohol dependence (SADQ) were predictive of Stroop interference. The exception referred to above was that the first variable, QPO, proved to have an inverse relationship to Stroop interference which was in the opposite direction to that predicted. This result will be addressed below together with the theoretical and clinical implications of the findings in general. The third prediction was not supported due to the failure to find significant interaction between group status, word type across trial one and two. Prior to any detailed discussion of these results it is necessary to re-visit the literature to relate the current findings to other recently published work.

Two groups of researchers published particularly relevant findings while the present study was being carried out. Cox & Blount (1995) recruited three cohorts of problem drinkers in Norway and the U.S.A. and compared their performance on a modified computerised Stroop test involving the colour-naming of alcohol, emotionally valenced and neutral words to that of selected controls. They found evidence of interference in both problem drinking and control groups although the tendency was for this to be more pronounced with the former, reaching statistical significance with one cohort (Experiment 1). A second experiment produced results which parallel those of the present study by demonstrating a substantial interference effect by the control group when colour naming alcohol words and consequently obscuring any hypothetical effect confined to the alcoholic group.

Stetter and colleagues recruited two samples of male alcoholic inpatients from a clinic in Germany. In the first study (Stetter, Chaluppa et al.1994) they administered a card based Stroop task consisting of alcohol-related words and semantically linked neutral words to alcoholics and age-matched healthy controls. Results confirmed a trend towards relatively slower colour naming by the clinic sample (N=30) for "alcohol" words compared to neutral words but this failed to reach statistical significance. Predicted relationships between alcohol consumption variables and Stroop interference were not observed. A subsequent study with a larger sample (total N=80) revealed more conclusive results. Again the investigators (Stetter, Ackerman et al. 1995) used a modified Stroop procedure and compared performance on colour-naming alcohol and neutral words across the two groups. Statistical analysis revealed a predicted colour naming delay with alcohol words relative to neutral words for the alcoholic group. Again statistical associations between the derived "interference score" (i.e. the difference between colour naming the alcohol words and the neutral words) were not found to be significant.

Together with the present results, the above findings point to the existence of Stroop interference by salient words in groups of detoxified problem drinkers, using both computerised and card format modes of presentation. This is consistent with the model proposed by Tiffany (1990) which predicts that abstinent or restrained

alcoholics will process alcohol cues in a controlled, effortful way. The Tiffany model is less specific about the role of particular cognitive processes such as selective attention, in contrast to hypervigilance theory (Eysenck, 1992), the information processing model of Williams et al (1988; 1997) and the model proposed by Wells & Matthews (1994). These latter models will provide the theoretical framework for more detailed discussion below. In advance of this however, two potentially important differences between the research introduced above and the present study need to be explored. Firstly, both Stetter et al (1995) and Cox & Blount (1995) recruited groups of inpatient alcoholics who had recently undergone detoxification from alcohol. Stetters' recruits had abstained from alcohol for an average of 14 days prior to participating in the study. Cox & Blount (experiment 1) do not specify the duration of abstinence prior to testing but it must be assumed that the earliest this occurred was after detoxification which generally requires at least a week of abstinence. The clinic Ss in the present study reported an average of just four days since last drinking alcohol. The implication here is that the inpatient Ss deprived of alcohol for longer would show more marked colour naming interference than the outpatient sample in the present study who drank more recently. This would account for the discrepancy between the present results and those based on inpatient subjects.

The second point relates to the characteristics of the control groups used. Stetter et al (1995) do not specify where they recruited their control Ss from and Cox & Blount (1995) describe their controls as employees in community centres (experiment 1) and " blue-collar workers", (experiment 2). These investigators therefore did not control for familiarity or expertise with regard to the stimulus words used. It needs to be borne in mind however that by virtue of their status as social drinkers controls had acquired some " expertise", possibly the reason why control Ss tend to display a significant Stroop delay with alcohol words over neutral words. Nonetheless, it is doubtful if this qualifies as expertise in the present context which implies enhanced personal relevance in addition to frequency and familiarity.

Recalling the findings of Dalgleish (1995), this factor could generate Stroop interference which would have a confounding effect on performance across experimental and control groups. While it is not clear whether the inpatient episode referred to by Stetter et al (1995) involved psychotherapeutic or educational programmes it seems safe to assume that an inpatient population would inevitably be exposed to terms associated with alcohol and alcoholism more than the outpatient cohort recruited for the present study. Engaging in lengthy discussions in a therapeutic milieu appears to fulfil the criteria for engendering expertise however and the present results suggest that, left uncontrolled, this factor could exaggerate the difference between clinical groups and controls on Stroop performance, thus accounting for the significant interactions found by these researchers. The possibility that the duration of pre-testing abstinence referred to above added to the effect size is also worth considering.

In summary, of the four studies which addressed the question of Stroop interference linked to alcohol problems, two have produced findings suggesting an attentional bias associated with alcohol-relevant terms manifested by recently detoxified alcoholics in comparison to controls. Two further studies have failed to find such an effect and the

present study produced results which fell marginally short of significance. The studies that unequivocally found the predicted effect, Stetter et al (1995) and Cox & Blount (1995) did not adequately control for expertise as a factor likely to generate attentional bias among clinic subjects, suggesting caution in interpreting these findings. The present study also has shortcomings. Inclusion of a condition with emotionally valenced words not related to alcohol would allow for more refined interpretation of the results by allowing for the separation of effects attributable to emotionality rather than personal relevance or familiarity. Similarly, recruitment of a cohort of Ss who were neither experts nor alcoholics would make for a more robust design.

The other study of direct relevance to the present findings is that of Gross et al (1993). In addition to addressing nicotine addiction, this study is distinguished by the use of a stronger design than those reviewed above, albeit with a small number of subjects (N=20). The direct manipulation of smoking status was accomplished through randomly allocating subjects to "maintain smoking" and "abstain" groups for 12 hours prior to testing. As described in the Introduction, the predicted effect of increased colour naming latency for smoking related words was observed for the abstinent group but not the smoking group. The pattern of scores obtained was that subjects allocated to the "smoking " condition showed faster colour naming of salient words than neutral words and the abstinent group showed the opposite tendency. One problem with this study that was noted earlier was the failure to select neutral words from a semantically homogenous category. This means that the two word lists differed not just in their degree of association with smoking but also in their potential for generating priming effects.

The Role of Expertise

The issue of expertise was controlled for in the present study by selecting controls who were involved in service provision for problem drinkers. The more direct aim of including this group was as a means of attempting to match the alcohol words for frequency across groups. This manipulation was not designed to explore the impact of expertise on relevant Stroop performance *per se* but to provide a more stringent criterion for identifying Stroop interference as a definitive feature of disordered alcohol use in a clinical population rather than an artefact of a drinking lifestyle or professional knowledge of the subject. Any observed differences between colour naming latency for alcohol words and neutral words across clinical and control groups could therefore be more confidently regarded as implicated in the regulation of addictive behaviour, specifically when effortful attempts are being made to modify it through participation in therapeutic programmes.

One possible explanation for the spectrum of results described above is that delayed colour naming is influenced by both expertise *and* the heightened emotional relevance these terms acquire in individuals experiencing alcohol related difficulties. In the research samples where Stroop effects have been demonstrated the clinical participants were "primed" for the salient words by virtue of their (assumed) engagement in therapeutic programmes in keeping with their in-patient status,

whereas the control Ss were neither similarly primed nor likely to regard the critical words as especially relevant. The present study to some extent orchestrated the converse of this scenario: clinical subjects were, as out-patients, likely to be less exposed to therapeutic programmes as intensive as their in-patient counterparts and, crucially, the control subjects were, by definition, experts.

The dual influence of expertise and emotionality on colour naming interference was investigated by Dalgleish (1995). He found a highly significant Stroop effect for his subjects who were required to colour name words linked to their area of expertise, ornithology. Bird names commanded more Stroop interference with this group than positively or negatively toned emotional words. This finding contrasted with Mogg & Marden (1990) who found no evidence of expertise impacting on colour-naming of rowing words by members of a college rowing club. Dalgleish (1995) speculated that the rowers might have acquired less familiarity with the terms in contrast to the ornithologists that he recruited, who were also attending a conference when tested. On this dimension, they appear seem more comparable to the control subjects used in the present study who were tested in the course of a working day. As no study has yet directly compared the Stroop performance of experts, alcoholic clinic attenders and a third "normal" group it is difficult to be conclusive about the relationship between expertise and emotional salience in the present context.

Evidence gathered from other client groups suggests that expertise does not account for all of the interference typically found in Stroop experiments. This is clear from studies of emotionally disordered individuals such as those recruited by Thrasher et al (1994). The finding here, it will be recalled, was that Stroop interference was differentially associated with clinical status of PTSD among a cohort who had shared the same traumatic experience. In accounting for the present findings it seems reasonable to conclude that expertise and emotionality associated with critical words contributed to the interference evidenced by subjects in both groups, but to differing degrees. In the control group the expertise effect generated more interference consistent with that found by Dalgleish (1995); the clinical group were also affected by the expertise effect but were additionally more susceptible to the generally negative emotional impact of the alcohol words. These words were selected on the basis of the degree to which they were rated by clinic attenders as "threatening " or "desirable" with the former rating as the criterion for selection. A potential difficulty with this procedure was that control subjects were not required to rate the words similarly to the clinic sample, but it is assumed that, on *a priori* grounds these commonly used terms were unlikely to have an anxiogenic impact.

The aim here was to devise a modified Stroop procedure that would have a defined emotional valence in addition to semantic relatedness to the concerns that brought the subjects into treatment. This would also allow for the findings to be more meaningfully placed in the context of emotional Stroop research, the majority of which focused on anxiogenic or threatening stimuli. Cox & Blount (1995, Experiment 2) did include positive and negative emotional words along with alcohol related words and found that colour naming latency was generally equivalent across different word types, although not confined to the alcoholic group. This implies that the Stroop interference displayed by the alcoholic group in this study was influenced by both the

emotionality of the words and the degree of personal relevance, familiarity or expertise associated with them. The design does not allow for more specific attributions to be made. Stetter et al (1995) used two sets of ten words which included negative terms such as "blackout" as well as possibly less emotive words such as "wine" in both lists and found no difference between the two in terms of colour naming interference. While emotional valence was not directly manipulated in this case comparable performance on the parallel forms suggests that colour naming interference can be generated by a broad range of different words associated with alcohol consumption and its consequences. The evidence suggests that the emotional valence is less important a component in generating Stroop interference than the semantic relatedness of the words to emotional concerns (Mathews & Klug, 1993). It was also noteworthy that the anxiety and depression scores did not predict Stroop interference with either alcohol relevant or neutral words.

The Relationship between Alcohol Use and Stroop Interference

The second aspect of the problem addressed in this investigation was an exploration of the relationship between alcohol consumption variables and performance on the measure of information processing, the modified Stroop. The combination of variables that accounted for most of the variance in Stroop interference (R square = .192) included self-reported duration of habitual or problem drinking, the average quantity consumed per occasion (QPO) and scores on the *Severity of Alcohol Dependence Questionnaire* (SADQ). These variables capture between them some definitive aspects of alcohol abuse and dependence and confirm the existence of a meaningful relationship between aspects of alcohol consumption and attentional bias. The SADQ score, which had the strongest relationship with the index of Stroop interference used as the dependent variable, is a robust psychometric instrument standardised on a sample of London clinic alcoholics similar to those described here. It provides a score that quantifies the extent of alcohol dependency according to self-reports of the chronicity of problems and features such as drinking to relieve withdrawal symptoms. Consistent with this, the relationship between duration of problem drinking (or in the case of controls regular drinking) also proved to be predictive of Stroop interference in combination with the other variables. Group status (clinical or control) was not predictive of Stroop interference alone or in combination with other variables.

The final variable to be discussed, QPO, was also predictive of colour naming latency but in a direction contrary to that predicted. This anomalous result is difficult to account for. One possibility is that subjects under-reported or underestimated their consumption, but it is not clear why similar potential biases are reflected with the other variables. Another tentative possibility is that there was a trend among subjects, particularly controls, who reportedly drank less on a given occasion to have more concern about the risks attendant on alcohol. This could influence the performance on the modified Stroop in the manner observed as these subjects would evidence both low QPO scores but high Stroop interference scores reflective of their *current* concerns (the question asked about the amount that is typically consumed currently). This is consistent with the fact that performance on the Stroop task is reflective of more than one factor, be it familiarity, concern or emotionality.

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Other variables not measured in the present study might also shed light on the issue. For example Green, Elliman and Rogers (1996) investigated the relationship between hunger, calorific pre-loading and colour naming of food and body shape words. These researchers concluded that the relationship between attentional processing and hunger was not linear, having found that calorific status of the subject was less influential in determining Stroop interference than the subjective rating of hunger provided. Unfortunately, a comparable measure of desire or craving for alcohol was not obtained in the present study. Nonetheless, the findings of Green et al (1996) suggest caution in accounting for Stroop phenomena. As these authors discuss, the findings of non-linearity parallel the results of Mathews & Sebastian (1993) who found unpredicted Stroop facilitation when their subjects were confronted with a real spider rather than a laboratory stimulus array.

Leaving aside discussion of particular variables, there is little in the literature with which to place the present findings in context. Of the four "alcohol Stroop" studies described above only Stetter et al (1994) and Stetter et al (1995) attempted to explore the relationship between some of the variables that featured in the regression analyses under discussion. In both studies, Stetter and co-workers used simple correlations to evaluate the interrelationships between the relevant variables. In the 1994 study significant relationships emerged between levels of alcohol consumed prior to admission and Stroop performance. Partly consistent with the present findings, average daily consumption and maximum daily consumption were modestly correlated with Stroop performance but this fell short of significance by a small margin. On this occasion however the relationship was in the predicted, positive direction. In the second study, utilising a larger (N=40) sample, no significant relationships emerged, although a few (e.g. level of withdrawal seizures) fell just short of the required level. The results are not however directly comparable to the present findings because Stetter and colleagues confined their correlational analysis to the alcoholic group and did not use multiple regression analysis.

Habituation to Stroop Interference

Predictions regarding habituation, as evidenced by decreasing colour-naming times across trials, were speculative in nature owing to the lack of empirical data with the relevant client group. While the same is true for the other predictions, there was a body of evidence from research in eating and emotional disorders pointing to the plausibility of attentional bias being implicated in addiction. As Green et al (1994) point out however very little is known about intra-session habituation to Stroop-like interference. The failure to find significant intra-session decrements in colour-naming "alcohol" words rather than neutral words does not however allow for complacency for two reasons. Firstly, the study was not primarily designed for rigorous testing of hypotheses regarding the role of the durability commanded by Stroop interference within testing sessions. Given the paucity of relevant data it was nonetheless considered justifiable to hypothesise regarding the pattern of Stroop interference observable within the test session. Thus, whereas Green et al (1994) employed five

experiment more difficult to compare directly. Secondly, there was a trend noted in the present study for performance by all Ss to be variable across repeated administration of the Stroop although this gain in colour-naming latency did not interact with group status or word-type. While the present study does not perhaps add significantly to the issue, data on intra-session habituation is essential if attentional bias effects are to be understood in the light of gains made in therapy, for instance. If individuals habituate to salient word stimuli with relative ease, within a test or therapy session, re-assessing the same individuals with words from the same categories is not going to prove a valid means of assessing changes in patterns of cognitive processing in the context of therapy gains. Returning to the findings of Green and co-workers, they concluded that the differential responding to these word categories pointed to the existence of qualitatively different concerns relating to food and body shape in anorexic patients. Logically, the next step is to see whether the words that command the more durable attentional bias continue to do so after remediation. The obstacle to doing this with addictive behaviours is that currently it is impossible to specify with confidence what particular word stimuli might serve this purpose.

Before fuller consideration is given to the interpretation of this aspect of the study it is necessary again to broaden the focus to include developments in the wider arena of information processing in emotional disorders. For the purposes of the present discussion it was timely that Williams, Watts, MacLeod and Mathews (1997) have reviewed the evidence in relation to attentional biasing with particular reference to the modified Stroop paradigm.

Williams et al Information Processing Model (1997)

In the revised version of their 1988 model Williams et al (1997) re-affirm the robustness of the data pointing to the existence of an attentional bias influencing the perceptual "pick-up" of information and the tendency of the dispositionally anxious individual to subsequently allocate processing resources towards stimuli disambiguated as threatening. This, they proposed, was based on the extent to which the stimulus had been primed or integrated by the formation of a strong pattern of encoding or internal representation. This automatic process is apparent in a wide range of psychological disorder, particularly where anxiety or threat is a factor. Williams et al (1997), however, point out that the failure to find an implicit memory bias with some groups of anxious patients is puzzling as this task reflects priming or processing fluency as much as tasks such as the emotional Stroop. The failure to reliably demonstrate implicit memory with anxious patients and problems with finding an explicit memory bias with depressed patients have led Williams et al (1997) to revise their theory, particularly in the way elaboration is modelled (p.300). Of more direct relevance to interpreting the present findings however is the effort Williams and his co-workers have invested in accounting for the emotional Stroop data which will now be addressed.

The parallel distributed processing (PDP) account of the original Stroop phenomenon was outlined in the Introduction and in fig 2 (Cohen et al 1990). It was considered potentially useful in relation to addictive behaviours by conceptualising strength of processing as a means of conceptualising practice, or perhaps any high frequency

behavioural response. Williams and colleagues have attempted to apply this connectionist framework to the emotional Stroop (Williams et al, 1996; 1997). In addition to strength of processing (in effect an operational definition of automaticity), Williams et al propose two additional ways in which interference occurs in the PDP model.

First, the resting level of activation for input units for emotional words might be higher. Following Cohen et al (1990), Williams et al (1997) assume a sigmoid activation function which means that in the middle range small changes in input lead to proportionately greater changes in output in the word reading pathway. The example used is the word "spider" having a higher level of resting activation than a neutral word such as "fireplace" in spider-phobic individuals. In a colour naming task, this higher level of resting activation for the word "spider" results in more activation output in the word reading pathway which increases the interference at the response module and hence increased colour naming latency.

Second, the input units can be subject to different levels of neuromodulatory control. Again relying on the example of Williams et al (1997), the suggestion is that input units that are historically associated with threat or loss become susceptible to modulation by neurotransmitters such as norepinephrine. Processing of an emotionally "tagged" word will lead to increased activity in the relevant pathways, ultimately leading to more colour naming interference. Theoretically, these three parameters of the PDP model can account for the emotional Stroop: increased practice accounts for the expertise effects in combination with the increased resting level of activation representing the personal concern component; the neuromodulatory influence on activation is involved in the frequently demonstrated colour naming latency associated with negatively valenced words by the clinically or sub-clinically anxious.

The extension of the PDP model to the emotional Stroop thus allows for the theoretical distinction to be made between colour naming latency associated with familiarity or expertise and emotionality explored by Dalgleish (1995). It also goes some way towards accounting for the findings that successfully treated clients with phobias show significant reductions in colour naming latency of phobia related words despite the necessary "expertise" acquired with these terms in therapy. (e.g. Lavy, Hout & Arntz (1993); Watts et al (1986). The modelling of Stroop interference in connectionist terms provides more flexibility in accounting for changes in response to therapy and the role of expertise. An advantage of the PDP model of the emotional Stroop is the specification of different processes operating within the framework. This provides readily testable hypotheses with emotionality and expertise predicted to contribute to different patterns of Stroop interference when subject to experimental manipulation. This would yield more conclusive evidence for the Williams et al (1996) proposals which, while consistent with some of the relevant data, are *post hoc* in nature.

A contrasting model is proposed by Wells & Matthews (1994) who regard Stroop interference as due to the *voluntary* execution of threat-monitoring plans. The Stroop task is not, however,"pure" with respect to either the upper-level, strategic processes

emphasised by Wells & Matthews (1994) or the lower-level, automatised processes that are crucial in the theorising of Williams et al (1988; 1997). It appears that the inherently ambiguous nature of the task extends to the interpretation of the results it produces. Nevertheless, the Stroop task does capture a component of the *involuntary* nature of the interference. The consistency with which colour naming latency with emotionally valenced words has been demonstrated by so many subjects in different studies raises the question of why, if this reflects strategic processing, it lacks the flexibility that is one of the hallmarks of controlled processing. The many subjects on whom the Stroop task has been inflicted have shown remarkable uniformity in the performance deficits they have displayed in attempting to colour name words of personal or emotional significance. This is consistent with the point made by McNally (1995) who regarded this inability to override the cognitive bias as convincing evidence of the involuntary and hence automatic nature of Stroop interference. McNally (1995) contrasted this with the subliminal Stroop paradigm where presumed lack of awareness precludes voluntary control strategies.

To recap, theorists such as Williams et al (1997) have applied PDP models in an effort to account for empirical data such as expertise effects and reduced interference following exposure based treatments. Three mechanisms were specified: strength of processing, resting level of activation of input units and different levels of neuromodulatory control. While this connectionist model seems well suited to accounting for the growth of automaticity and direct processes generally, indirect or controlled processing might not prove so amenable (Cohen, Servan-Schreiber & McClelland, 1992). Applying a contrasting framework, Wells & Matthews (1994) proposed a model which emphasised more strategic regulation of attentional processing which suggests that Stroop interference is due to the operation of threat monitoring plans in response to threat stimuli. The supposed voluntary nature of this monitoring of threatening or emotionally salient material is open to question. McNally (1995) regarded the apparent inability of Ss to choose *not* to become diverted by word meanings as evidence of the involuntary, and hence automatised, nature of the processing that occurs with salient words. The debate concerning the relative automaticity of Stroop interference is important theoretically for both the models proposed by Wells & Matthews (1994) and by Williams et al (1988; 1997) and exemplifies the difference between them.

Information processing in relation to addictive and appetitive behaviour.

In theory the extension of the PDP model to accommodate the various and occasionally contradictory findings generated by the emotional Stroop research is also applicable to the present results. In particular the finding that both clinical and expert groups displayed significant colour naming interference (102 ms and 70ms respectively) is consistent with this disrupted performance being attributable to different information processing patterns within a connectionist framework such as that outlined by Cohen et al (1990). The greater degree of interference displayed by the clinical group could thus reflect the cumulative effect of greater familiarity, leading to more interference at the output stage, and higher resting activation levels of the target words. This means that a word like "alcohol" would be more likely to

generate colour naming delay in alcoholic individuals for both of these reasons, compared to a neutral word. With regard to the control or "expert" group however there is only one dominant source of interference, the familiarity or extended practice factor that is an integral component of the expertise.

This implicates only two of the possible sources or mechanisms of interference specified by Williams et al (1996). The third source of interference is the neuromodulatory control mechanism that selectively increases the activity output in word pathways associated or "tagged" for threat. Theoretically it is equally plausible to speculate on a neuromodulatory control process in relation to addictive behaviour. Powell et al (1990) outlined the distinction between the aversive and appetitive systems at the neurophysiological level, which were described as the *behavioural inhibition system* (BIS), and the *behavioural approach system* (BAS). Although Williams et al (1996) do not describe the possible mechanisms of neuromodulatory control in detail, the involvement of the neurotransmitter norepinephrine and its concentration in the locus coeruleus is specified, which are part of the BIS. The appetitive system, the BAS, is also regulated by neurotransmitters, which are selectively active in different areas of the brain and are subject to direct and hedonic stimulation by drug ingestion (Nutt, 1996). The possibility that neurotransmitters such as dopamine could be influential in mediating Stroop interference remains a speculative hypothesis at this stage. In one sense at least it is less so than the proposal of Williams and his colleagues as drug seeking behaviour is reinforced directly by the action of the ingested substance on specific receptor sites. This eminently conditionable response persists in the absence of the drug of choice and is arguably the definitive component of addictive behaviour. This tendency to deliver powerful reinforcements directly was contrasted by Wise (1988) to the stimulation due to primary reinforcers like food or water which require transformation into nerve impulses in order to generate hedonic experience.

Drugs such as cocaine or opiates "saturate" receptor sites directly and alcohol directly stimulates the dopaminergic system. Williams et al (1996) were however able to base their speculation about neuromodulation on a substantial database of research studies, albeit without direct manipulation or measurement of the neurotransmitters implicated. Conversely the research exploring the neurobiology of craving reviewed by Wise (1988) does not address cognitive processing, not least because much of the findings considered were based on laboratory animals. This does not prevent Wise from discussing the apparently long "memory" evidenced by both human and animal subjects for the positive reinforcing effects of drug and alcohol ingestion (i.e. the persistence of the conditioned response) compared to the relatively less enduring effects of withdrawal discomfort. This is entirely consistent with the high relapse rates observed in those who attempt continuing abstinence from drugs which were used addictively.

Goldman & Rather (1993) proposed that the hypothetical memory for drug effects consists of *expectancies* which, crucially in addicts, cluster positive consequences relatively quickly and tightly together and in relative isolation from expectancies about the aversive consequences of drug use. They described supportive findings when they employed multidimensional scaling techniques with a sample of heavy and

light drinkers. Further evidence of a relatively automatic, proceduralised, response to cues mediated by expectancies comes from work with lexical decision tasks and disambiguation of words. Hill & Paynter (1992) found that alcohol dependent Ss were faster to make a lexical decision when primed by alcohol related words than were non-dependent social drinkers. The aptly named Earleywine (1994) asked his Ss to define ambiguous words such as "toast" and found significant correlations between the definitions (alcohol or non-alcohol related) and alcohol consumption variables. The sample were female undergraduates who reported drinking on average less than seven standard units of alcohol per week which raises doubts about the relevance of the results. Additionally, research relating alcohol consumption to spreading activation of expectancies in response to priming manipulations (Weingardt, Stacey & Leigh, 1996) has implications for behavioural decisions about drinking.

The PDP model, as developed further by Williams and his associates can accommodate some key findings in the emotional Stroop literature, in particular the superficial similarity in colour naming performance between expert and emotionally disordered individuals, which appears to change in response to treatment with regard to the latter (Watts et al,1986). Recent findings suggest caution in this regard as Lovell, Williams and Hill (1997) found that Stroop interference with body-shape words was observed in a recovered group of anorexics. This group was recovered according to self-reports and clinical and psychometric evidence. In contrast to the earlier study by Watts et al (1986) the design was limited by the lack of baseline Stroop data for the clinical group who were self-selected through newspaper advertisements and then compared to currently symptomatic anorexics. The researchers therefore were not in a position to control the type and intensity of the treatment or factors which might have motivated the recovered individuals to put themselves forward for the research.

Summary and Conclusions

The PDP model proposed by Cohen et al (1990) and applied to the emotional Stroop paradigm by Williams et al (1997) can account for the present finding that both clinic alcoholics and experts in treating alcohol use disorders evidence significant interference in colour naming salient words, with a non-statistically significant trend for this to be more marked with the former. Distinguishing between the performance of clinical and expert subjects is supported by assumed increases in the resting levels of activation in concern related input units of the PDP architecture combined with a possible mechanism for neuromodulation and increases in strength of processing respectively. Similarly, the emergence of significant predictive relationships between aspects of alcohol consumption such as the duration of habitual drinking and Stroop interference is consistent with an acquired information processing bias of the type the original PDP model was constructed to account for by proposing variables such as strength of processing. These processes, assumed to reflect the prior learning history and personal relevance of the word stimuli, provide an explanation for the emotional Stroop effect and why it can be shown to diminish following successful psychotherapy or adjustment, despite the necessary engendering of "expertise" as part of the treatment. This account is consistent with the pattern of Stroop interference demonstrated by Ss in both groups in the present study, although this would be more

conclusive if treatment was directly manipulated with repeated administration of the Stroop test. Experimental control of the degree of expertise, perhaps by including a group of "non-experts" would also be a useful factor to include as an independent variable.

Clinical Implications

The distinction between *automatic* and *controlled* cognitive processes was discussed earlier and the implications for addictive behaviour were briefly explored. Of clear relevance was the apparent autonomy of behaviour governed by automatised processes, particularly when effortful control was called for. Individuals embarking on therapeutic programmes aimed at modifying addictive behaviour such as compulsive drinking experience at first hand the conflict between automatic and controlled processes. Beck and his colleagues captured some of this competition in the following quote: " *Cravings and urges tend to be automatic and may become autonomous; the thrust of therapy is to provide voluntary methods for managing them.*" (Beck et al, 1993, p.40). The focus of therapeutic intervention specified here is the hypothesised delay between the experience of the craving and the formulation of a plan aimed at satiating it. While this over-simplifies the complex processes involved it does provide a stepping stone from theory to practice. The broad question that needs to be addressed relates to how the present results and other recent findings might alter the way in which addictive behaviours are responded to therapeutically. The discussion will focus on the implications for assessment and intervention strategies.

Assessment

Recent approaches to assessment have emphasised a systems approach embracing the biological, social and psychological aspects of addictive behaviour (e.g. Donovan & Gordon, 1988). Apart from the obviously biomedical aspects of substance misuse assessment, involving laboratory screening of body fluids or other specimens such as hair assessment, has relied on self-reports to a large degree. The resulting data is thus susceptible to the same influences discussed in detail by Williams et al (1997 , Chapter 10). This means that when an individual gives an account of his or her own drug use, or completes a questionnaire probing similar issues, the resulting data will reflect a range of distortions. These will bias the responses, particularly when attributional judgements are called for (e.g. "Why do you drink excessively" ?). The situation is further complicated in the field of substance misuse by socio-cultural beliefs about "denial" being a feature of addiction. There is some irony in a situation where an interviewer's schematic beliefs lead him to doubt the credibility of an interviewee whose self-reports are nonetheless distorted, but due to different processes.

There is a risk of overstating the potential for confusion here: by drawing on different sources of information the experienced interviewer can avoid much of this. Nonetheless, an important point is that as theorists begin to speculate on the role of automatic processes in addiction (e.g.Tiffany, 1990), an approach based largely on self-report is going to miss an important aspect of the behaviour i.e. its automaticity. There is thus a clear theoretical case to be made for some measure of automatic

cognitive processing to be considered as part of the assessment of addictive disorders. What is equally clear is that, given the current state of knowledge, this would be unjustified at present.

The findings discussed here included significant relationships between standard measures of alcohol dependence and self-reported behaviour on the one hand and Stroop interference on the other. The most important relationship to emerge was between the SADQ, which measures alcohol dependence, and Stroop interference specific to alcohol relevant words. Other findings (Cox et al 1995; Stetter et al 1995) implicated Stroop interference in alcohol misuse. Similarly, the degree of Stroop interference displayed by eating disordered individuals has been proposed as a quantitative index of psychopathology (Ben Tovim et al., 1988; 1991). In fact, given the finding described by Williams et al (1996) for PTSD sufferers to consistently show higher levels of Stroop interference than those with other forms of anxiety disorder (the former displaying 200-300 ms whereas the latter rarely exceed 100 ms) there are logical reasons for predicting that a task such as the Stroop has a natural advantage with appetitive disorders. This is because both PTSD and restrained use of drugs or food are associated with unwanted thoughts or impulses (see e.g. Polivy & Herman, 1985). Insofar as the emotional Stroop reflects difficulty in suppressing the cognitive processing of the word meanings it suggests itself as an appropriate technique for exploring disorders where effective impulse control is synonymous with therapeutic gain.

To date however no investigation has monitored Stroop interference over an extended period with a group of problem drinkers, perhaps coinciding with therapeutic intervention. Until this more robust type of study is carried out the implications for assessment will remain unclear. Consideration also needs to be given to other approaches to assessing the role of automatic processing. The procedure used in the present study, the modified Stroop, reflects to some degree the level of automatic task-irrelevant processing that takes place but responses are also reflective of strategic influences. It is also prudent to acknowledge the necessary limitations of scope and design in both the present study and other relevant work reviewed here which imply a cautious approach in generalising the findings.

Therapeutic Intervention

Consideration of this topic is necessarily more speculative than the discussion of assessment as there is a very meagre empirical database upon which to draw any conclusions. It needs to be recalled that the modified Stroop is essentially a measurement or assessment tool, albeit still under research and development, but as such does not have a necessary or direct implication for therapeutic programming. Nonetheless, the growing acknowledgement of the role of attention in the regulation of emotion and behaviour (see Wells & Mathews, 1994) has important implications for how addictive behaviour is conceptualised and therefore how treatment is modelled and applied.

The present study was initiated specifically to learn more about the apparent attentional bias displayed by individuals engaged in treatment. Anecdotally, this seems to be associated with beliefs asserting the ubiquity of alcohol in the environment. The information processing approach described by Williams et al (1988; 1997) raises the processing bias being causally implicated in the acquisition and maintenance of such beliefs. In the example quoted by Williams et al (1997, p.16), a man states that "..everywhere I look there are dangers". The information processing model offers an alternative account of events by proposing that this anxious man is selectively attending to environmental events that are easily accommodated into a biased schematic structure. The informed therapist would therefore point out to the client that a more accurate reflection of what was guiding his appraisals would be "everywhere there are dangers, I will look" (Williams et al 1997, p.42). The therapist could add that this process occurs very rapidly and can detect danger or threat stimuli very efficiently, with little regard for the many non-threatening features that are available in the environment. The possibility that addictive behaviour is similarly influenced by automatised processing biases suggests that the addicted individual will acquire comparable idiosyncratic beliefs about the world *apropos* their drug of choice. Put simply, this predicts that those abstaining from, say, alcohol will display beliefs such as "everywhere I look I see alcohol" which can be subject to a similar inversion to that quoted above. This means that during and following treatment for addictive disorders individuals so engaged are susceptible to having their responses triggered by environmental stimuli that, while not perhaps as ubiquitous as implied above, are certainly common enough to frequently capture the attention of those predisposed to respond by virtue of their addictive tendencies. A further implication is that, even in settings where cues associated with the proscribed substance are in fact rare, individuals with an acquired information processing bias will nonetheless detect and process these cues with greater facility.

Much of the above speculation follows directly from theorists such as Williams and his colleagues have explicated the role of cognitive processes in the field of emotional disorders. However, in the light of the results presented above and other new findings more direct evidence can be brought to bear in an effort to explore the implications for therapy specifically with addictive behaviour. Firstly, it can be recalled that evidence from three separate studies has pointed to abstinent problem drinkers displaying Stroop interference. These findings are somewhat equivocal due to procedural and interpretative difficulties. The role of expertise, for example was not addressed or controlled for in the Cox et al (1995) and Stetter et al (1995) studies. To summarise the key findings of the present study, when expertise was controlled for by comparing experts' responses to the Stroop task with those of clinical recruits the predicted interactions between word type and clinical status were not found. The data showed moderate levels of colour naming latency with both groups however which in the form of a derived interference index approached statistical significance when compared across groups. The predictive relationships observed between aspects of alcohol use and Stroop interference is also noteworthy. The important question is to what extent the pattern of Stroop interference observed can be generalised to that of restrained drinkers in the real-life settings. This is amenable to further investigation but would require a longitudinal design involving the monitoring of cognitive processes such as Stroop interference in the context of therapeutic change or relapse.

Given the dearth of evidence in relation to the clinical implications of cognitive processing biases in addictive behaviours and the related absence of a theoretical model it is again necessary to turn to more thoroughly researched areas. Three texts, Wells and Mathews (1994), Williams et al (1988; 1997) and Eysenck (1992) are of direct relevance here.

Wells and Matthews (1994)

In the first text the authors tackled the question of whether attentional disorder is caused by or is a consequence of emotional problems (Wells & Matthews, 1994 Chapter 11) and concluded that the relationship was bi-directional based on a review of experimental, clinical and longitudinal data. Attentional processes can be viewed as influential at different stages in the acquisition and maintenance of emotional disorders however. There are nonetheless considerable methodological problems in addressing the causality question such as the likelihood that both emotionality and cognitive processes such as attentional bias both change in response to psychotherapy, as Wells & Matthews point out. This illustrates the point that just because cognitive processes are not targeted directly as levers of therapeutic change does not mean they are not implicated. While Wells & Matthews (1994) cite their own efforts at therapeutic intervention aimed at altering self-focused attention the single case and small-N studies do not provide very generalisable evidence of remediation, although the reported gains were present up to twelve months later. Given the lack of direct evidence connecting attentional disorder or biasing to clinical gain, it seems

processes they are not represented in a form available to conscious awareness and are therefore unreportable (see Williams et al, 1997, Chapter 10 for a detailed discussion). Such nonconscious activity can however *indirectly* impact on conscious awareness permitting a form of retrospective inference from that which is actually reported. This implies that it might be useful to encourage clients in therapy to *guess* the nature of possible unreportable, automatic thoughts that might be implicated in emotional disorder. Interestingly, Williams et al (1997, p.272) speculated that individuals with "maladaptive control strategies" in relation to eating, gambling or drinking may be overgeneralising rules acquired in some earlier context. While this point is not developed further, it is consistent with the behavioural autonomy apparent in addictive behaviour regardless of the consequences or the appropriateness of such actions in a particular setting.

Hypervigilance Theory

Eysenck (1992) acknowledged the influence of the Williams et al (1988) model but provided a more comprehensive account of other attentional phenomena such as scanning, distractibility and breadth of attention in his *hypervigilance* theory(see p. 19 above).

This model also predicts Stroop interference with salient words by normals with heightened anxiety or clinically anxious patients. The selective bias is latent rather than manifest however and with reduced anxiety the attentional processes specified by Eysenck return to normal, although there are exceptions. Recovered anxious patients, for instance are manifestly more susceptible to threatening distracters compared to normals (Mathews, May, Mogg & Eysenck, 1990). More generally however the concept of attentional processing that prioritises the detection of particular environmental events, such as those perceived as threatening by the anxious individual, can be usefully applied to addiction, a defining feature of which is the propensity for those affected to prioritise the pursuit of their drug of choice.

Social Learning and Conditioning Models of Addiction

The *social-cognitive* models of treatment such as those described by Marlatt (1985) emphasise the role of conscious cognitive processes in the regulation of addictive behaviour. Some indications of the implicit nature of these thought processes are provided by the concept of *seemingly irrelevant decisions*. These apparently trivial decisions can bias the individual towards relapse e.g. deciding to avoid heavy traffic by using a different route home which *inter alia* passes some favourite bars or places where drugs are usually available. Similarly as referred to above, Marlatt and his collaborators advocated the teaching of anticipatory coping skills, using the analogy of a driver attending to road signs in order to cope with the impending hazards. This and similar approaches to treatment (eg Monti, Abrams et al 1989) diligently apply the techniques derived from social learning theory but leave cognitive processing out of their theorising, except for the more general references to higher level processes such as decision making. This exemplifies a tendency to emphasise the role of secondary appraisals and strategic responding in general at the cost of ignoring the potential role of processes such as priming and disambiguation of stimuli.

Cue exposure approaches reflect an essentially behaviourist view of the acquisition and subsequent fate of addictive behaviour. There is no account of attentional processing of cues in relation to the detection of and subsequent processing of salient cues. Tiffany (1990) has speculated about the possibility of abstinent addicts processing cues in a *controlled* rather than *automatic* manner. As pointed out above (p.10) a significant minority, about one third of abstinent alcoholics, demonstrated conditioned responses when exposed to pertinent cues (Rohsenow et al 1992). This implies a selective, attentional mechanism which is at present not acknowledged in models such as that proposed by Tiffany. Nevertheless evidence suggests that those who perform passively or slowly in response to scenarios involving cue presentation do less well in terms of treatment when followed up (Monti et al 1989). This could reflect a heightened level of distractibility by those who were less efficient in their response due to the operation of an attentional bias and selective processing of specific alcohol cues at the expense of deployment of effective coping skills. Similarly the "driving hazard" analogy referred to above could, from a cognitive processing perspective, lead to distraction by the warning sign with the effect of *disrupting* coping in the face of the impending danger.

Insofar as the present results suggest that there is a tendency for those most dependent on alcohol to display more Stroop interference with relevant words, the findings provide some empirical support for the involvement of a processing bias in alcohol dependence. The relative novelty of these findings is apparent in contrast to the extensive clinical and research literature based on behavioural and social learning models. These approaches have generated effective therapeutic interventions and continue to grow in the scope of their applications. Data concerning the role of selective attention in addiction is, at this stage, of primarily theoretical value. Effective practice is the other side of the coin however, which leads back to the statement from Beck et al (1993) quoted at the beginning of this section. The currency or discourse of therapeutic encounters is essentially strategic and controlled rather than automatised. More specifically, the goal of therapy is to enhance the degree of choice the individual can exercise in the face of the often involuntary imperatives of addiction. The present findings provide some empirical support for this view. Treatment approaches such as those of Marlatt & Gordon 1985) and Monti et al (1989) which emphasise the acquisition of specific coping skills can also derive support from the idea that a continuum of automaticity underlies the acquisition of addictive behaviour. As has been discussed the demonstration of meaningful relationships between the chronicity of drinking behaviour and Stroop interference are consistent with this notion. Acknowledging the role of automatised cognitive processing therefore validates the emphasis on teaching alcoholics coping skills, which with repeated practice will acquire more fluency and autonomy consistent with the process of cognitive skill acquisition described by Anderson (1982) as progressing from *declarative* to *procedural*.

Furthermore, viewing addiction from a dual-processing perspective might help resolve some of the negative stereotypes that lurk within some more traditional approaches to treatment, such as "12-step" models (Alcoholics Anonymous,1939). These ideas have had a profound influence on socio-cultural responses to alcoholism

and addiction generally, although not always consistently (cigarette smokers generally avoid being labelled as "unmotivated", "in denial", or worse). The first of the 12 steps is " *We admitted we were powerless over alcohol*". The cognitive perspective on this assertion would be more prosaic, emphasising the relatively circumscribed nature of the loss of control and linking this state to the dynamic interaction between controlled and automatic processes. The apparent paradox in the 12-Step approach is that once the powerlessness is acknowledged it can be transformed into control, but only by appealing to a "higher power". Tacit acknowledgement perhaps that in a contest between the automatic and the controlled, mere human willpower is regarded as insufficient to determine the outcome.

Overview of Therapeutic Implications

Most of the above discussion could be divided into two overlapping categories. Firstly, the investigation of attentional processes in relation to addiction offers a new perspective which has important implications for how addictive behaviour is conceptualised and ultimately how it is responded to therapeutically. The analogy with anxiety disorders is once again useful here. Consider the clinical presentation of panic attacks occurring "out of the blue" combined with experimental evidence such as that of Ohman & Soares (1993; 1994) pointing to the unconscious and automatic nature of phobic fear. Substituting the experience of drug related craving for panic illustrates the relevance of these findings for addictive disorders. Evidence for selective processing of information related to specific aspects of the addictive syndrome which is resistant to voluntary suppression and control is of direct relevance to those affected.

Recalling the description of the role of naturalistic cues as "the final common pathway" of relapse (Cooney et al, 1987) it is crucial that the cognitive processes that support the detection and processing of that stimulus are described. As referred to above, not all drug-dependent individuals display conditioned cue reactivity and even when cue exposure was investigated as part of a controlled trial, different outcomes were reported (Powell, et al, 1993; Dawe et al (1993). More generally, discussion of issues such as the role of awareness and the degree to which apparently automatised responses are amenable to verbal persuasion echoes that in the broader field of clinical psychology. This debate, concerning the role and relevance of verbally mediated therapy, is ongoing with recent well argued, if conflicting, contributions from McNally (1995) and Beck & Clark (1997). A more integrative review of the conceptual origins of the behavioural and cognitive components of therapeutic change (Brewin, 1996) places the debate in a broader and more meaningful context.

Second, the foregoing has implications for the conceptualisation and conduct of existing models of the *therapeutic response* to addiction such as exposure based and social learning models. A focus on cognitive processing could help reconceptualise therapeutic intervention in a manner analogous to that proposed by Beck & Clark (1997) for schema-based cognitive therapy for anxiety disorders. Recent reviews such as that of Saunders & Houghton (1996) suggested that relapse is "far too complex" to model or that the reliability and validity of the taxonomy of relapse proposed by Marlatt & Gordon (1985) are not adequate (Madden, 1996). Other psychological

disorders are equally, if not more, opaque. This has not prevented the specification of clear, refutable models such as that of Williams et al (1988;1997), or indeed the model proposed by Marlatt whose endeavours were described as "attempting the impossible" by Saunders & Houghton (1996). A more measured response to current conceptualisations of relapse would emphasise the neglect of specifying a role for cognitive processes, particularly those displaying features of automaticity. Over reliance by researchers on retrospective self-reports by addicted patients of their previous experiences of relapse could account in part for the poor predictive validity such reports reveal in relation to subsequent relapse. Theoretically, if resumption of drug use reflects the influence of automatic processes, reports based on *explicit* memory for relapse situations should be treated cautiously, not least because negative affect is linked to both resumption of addictive behaviour and mood congruent recall bias.

Future Research on Cognitive Processing and Addiction

Overview

Reappraising the literature three years after the initial search for findings to shed light on the role of attention in addiction suggested that matters had not changed much: the field of cognitive processing research in clinical contexts has maintained its apparently symbiotic relationship with anxiety and depressive disorders. This trend was reflected in the revised version of Williams et al (1997) information processing account of anxiety and depression. Similarly Williams et al (1996) reviewed the now extensive literature on the emotional Stroop and psychopathology but confined their article to studies of anxiety and depression. There are of course clear theoretical grounds for this selectivity as a fundamental aim of the model proposed by Williams and colleagues is the lawful relationship between cognitive processes such as priming and subsequent elaboration on the one hand and anxiety and depression on the other. Regarding the one study they cited in relation to alcohol abuse and Stroop performance Williams et al (1996) concluded that there were insufficient data in this area from which to draw any conclusions.

Despite the accumulation of more data since the Williams et al (1996) review there remains a vacuum in the field of addiction and cognitive processing. The only explicit information processing model that addresses addictive behaviour (Tiffany, 1990) does not specify a role for attention. It may well be that a former dependent drinker might process urges in a controlled, strategic manner as the model proposes. Consider for instance the existence of a pre-attentive mechanism, or network of "lower level" units in connectionist terms, that is selectively activated by appetitive cues. This will influence subsequent resource allocation, possibly by the activation of more elaborated representations of the stimulus. The resulting negative impact on concurrent processing is along the lines predicted by Tiffany but for different reasons. Modelling the cognitive processes involved in addiction will need to account for the possibility of a "strong" form of attentional bias which has acquired a high degree of

automaticity and is therefore non-volitional, pre-conscious and a key component of a generally hypervigilant system. In the following section some possibilities for future research are explored.

Attentional Bias and Therapeutic Change

There are currently no research findings on the relationship between attentional bias and therapy outcomes in addiction. This is a substantial obstacle to understanding the role of selective processing in therapy. A specific problem lies in understanding the extent to which processing biases remain after treatment and impact on relapse rates. The key variables are cue-conditioned phenomena such as autonomic arousal and subjective experiences of compulsion to engage in drug use. If, as seems possible, this heightened state of arousal is associated with particular cognitive processes such as narrowing of attention and disruption in processing of other tasks it deserves further exploration. This would involve *in vivo* stimuli and could replicate the work of Mathews & Sebastion (1993) who found unpredicted speeding of colour naming when fear was evoked by the physical presence of phobic stimuli. Combined with the findings of Green et al (1996), who found that the most hungry Ss evidenced the least Stroop interference, this points to a more complex, non-linear relationship between subjective experience of arousal and attentional bias.

Methodological and Conceptual Diversity

Currently the modified Stroop paradigm is the most commonly used method of assessing attentional bias despite some doubts as to what cognitive processes it actually measures. This presents the prospective researcher with a dilemma: more "process pure" paradigms such as the dot probe and dual-task procedures that for instance separate spatial location of stimulus components do not have the benefit of the substantial Stroop data from a broad spectrum of psychological disorders. Information processing tasks such as colour-naming necessarily involve problem solving and hence a strategic component (Logan, Zbrodoff & Williamson, 1984). These researchers found that this strategy-dependent effect was limited by increasing task demand, such as having to colour name one of a total of four colours rather than from a maximum of two. More generally there is evidence that task procedure and format can impact on performance e.g. computerised Stroop presentation generates different results to card based formats (Dalgleish, 1995) This points to the possibility that different cognitive processes are involved in what could reasonably be viewed as (at least superficially) similar tasks insofar as they reflect selective attentional processing.

On balance therefore, it seems safe to endorse the modified Stroop for further research both on the basis of the large database linking this paradigm to psychological dysfunction and the consistency with which it reflects selective processing of a largely involuntary nature. This reflects only one aspect of automaticity. There is, for instance, no published work on possible subliminal Stroop effects in this field. Such

research would broaden understanding of the role of automaticity in addictive disorders. Testing hypotheses about semantic processing without conscious awareness would prove to be important theoretically and would help to develop a broader understanding of the role of automaticity in addiction.

Conclusions

The findings discussed above point towards a potentially fulcral role for automatised cognitive processes in addiction. Insofar as attentional bias was shown to be meaningfully related to patterns of alcohol consumption and indices of alcohol dependence they are consistent with findings in the broader arena of psychological disorder: relatively automatised cognitive processes appear to be implicated in the persistence of dysfunction while remaining resistant to effortful control and introspection. Based on the small number of empirical findings available an emerging hypothesis is that the repetitive self-administration of drugs is increasingly supported by cognitive operations and architecture that have acquired a bias towards the pursuit of the relevant consummatory goal. It needs to be borne in mind however that theorising based on such a small number of empirical findings needs to be cautious. The extant studies, including the present one, are not sufficiently robust enough to form the basis of a conclusive overview. Moreover, the central hypothesis regarding attentional bias was not supported, although the recruitment of control Ss on the basis of their expertise was a factor here. Nonetheless, the possibility that attempts at self-regulation or cessation of drug use conflict directly with the automatic cognitive processes and in so doing are frequently overwhelmed is worthy of further investigation. This merely acknowledges what anyone who has struggled with addictive behaviour would endorse but a cognitive perspective provides a means of conceptualising this in more precise quantitative and objective terms. Such pronouncements will remain speculative until further research investigates cognitive processes such as selective attention in the context of lasting behavioural change.

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APPENDICES

APPENDIX I

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Years in Education	Equal variances assumed Equal variances not assumed	1.640	.205
Alcohol Dependence Score	Equal variances assumed Equal variances not assumed	20.938	.000
Depression Score	Equal variances assumed Equal variances not assumed	50.764	.000
Anxiety Score	Equal variances assumed Equal variances not assumed	2.691	.106
Duration of Problem Drinking (years)	Equal variances assumed Equal variances not assumed	1.867	.177
Quantity per Occasion	Equal variances assumed Equal variances not assumed	45.931	.000
AGE	Equal variances assumed Equal variances not assumed	.605	.439

Tests of Within-Subjects Effects

Measure: MEASURE_1
Sphericity Assumed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
TRIAL	816.073	1	816.073	40.752	.000	40.752	1.000
TRIAL * GROUP	55.392	1	55.392	2.766	.101	2.766	.374
Error(TRIAL)	1261.608	63	20.026				
WRDTYPE	23.995	1	23.995	1.803	.184	1.803	.262
WRDTYPE * GROUP	9.758	1	9.758	.733	.395	.733	.135
Error(WRDTYPE)	838.396	63	13.308				
TRIAL * WRDTYPE	1193.478	1	1193.478	62.285	.000	62.285	1.000
TRIAL * WRDTYPE * GROUP	42.345	1	42.345	2.210	.142	2.210	.310
Error(TRIAL*WRDTYPE)	1207.173	63	19.161				

a. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1
Sphericity Assumed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
TRIAL	604.815	1	604.815	45.232	.000	45.232	1.000
TRIAL * GROUP	18.836	1	18.836	1.409	.240	1.409	.215
Error(TRIAL)	775.542	58	13.371				
WRDTYPE	45.202	1	45.202	4.347	.041	4.347	.536
WRDTYPE * GROUP	25.217	1	25.217	2.425	.125	2.425	.334
Error(WRDTYPE)	603.114	58	10.399				
TRIAL * WRDTYPE	988.278	1	988.278	59.961	.000	59.961	1.000
TRIAL * WRDTYPE * GROUP	20.741	1	20.741	1.258	.267	1.258	.197
Error(TRIAL*WRDTYPE)	955.953	58	16.482				

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Transformed Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
TRIAL	TRIAL_1	604.815	1	604.815	45.232	.000
TRIAL * GROUP	TRIAL_1	18.836	1	18.836	1.409	.240
Error(TRIAL)	TRIAL_1	775.542	58	13.371		
WRDTYPE	WRDTYPE_1	45.202	1	45.202	4.347	.041
WRDTYPE * GROUP	WRDTYPE_1	25.217	1	25.217	2.425	.125
Error(WRDTYPE)	WRDTYPE_1	603.114	58	10.399		
TRIAL * WRDTYPE	TRIAL_1*WRDTYPE_1	988.278	1	988.278	59.961	.000
TRIAL * WRDTYPE * GROUP	TRIAL_1*WRDTYPE_1	20.741	1	20.741	1.258	.267
Error(TRIAL*WRDTYPE)	TRIAL_1*WRDTYPE_1	955.953	58	16.482		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Transformed Variable	Noncent. Parameter	Observed Power[a]
TRIAL	TRIAL_1	45.232	1.000
TRIAL * GROUP	TRIAL_1	1.409	.215
Error(TRIAL)	TRIAL_1		
WRDTYPE	WRDTYPE_1	4.347	.536
WRDTYPE * GROUP	WRDTYPE_1	2.425	.334
Error(WRDTYPE)	WRDTYPE_1		
TRIAL * WRDTYPE	TRIAL_1*WRDTYPE_1	59.961	1.000
TRIAL * WRDTYPE * GROUP	TRIAL_1*WRDTYPE_1	1.258	.197
Error(TRIAL*WRDTYPE)	TRIAL_1*WRDTYPE_1		

a. Computed using alpha = .05

APPENDIX II

APPENDIX

COMPLETE LIST OF ALCOHOL RELATED WORDS

Sober

Bottle

Addiction

Dependence

Binge

Bender

Lapse

Slip

Relapse

Boredom

Liver

Pub

Off-Licence

Detoxification

Buzz

Recovery

Drunk

Whiskey

Beer

Glass

Hangover

Alcohol

Spirits

Vodka

APPENDIX III

ADDICTION

RELAPSE

ALCOHOL

DEPENDENCE

DRUNK

ALCOHOL

RELAPSE

DRUNK

DEPENDENCE

ADDICTION

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APPENDIX IV

RESEARCH STUDY

Initial instructions

I am interested in finding out how those who have had problems with alcohol might differ from those who have not experienced such problems. You will be asked to complete some questionnaires and to respond to some words. If you have any questions they will be addressed afterwards.

CONSENT FORM

I agree to take part in this research project. I have read the summary above. This will involve completing a number of questionnaires and other tasks. I understand that the procedure is not part of the treatment programme itself and I can decide not to participate or to withdraw at any time. I also understand that I may be asked to provide a blood or urine sample for analysis or to be breathalysed.

NAME.....

SIGNATURE.....

Thank you

Frank Ryan
Clinical Psychologist

Explanation (post hoc):

The aim of the experiment was to see whether those who have experienced problems with alcohol are more likely to notice or pay attention to familiar and probably emotive words like " binge" or "drunk" than more neutral words such as "chair". This might seem an obvious thing to expect but what is being studied here is **when** this occurs. It was expected that you and the other participants would be distracted from naming the colours of the alcohol-related words automatically as this might happen before you were aware of the meaning of the words. This could mean that you are directing your attention to words associated with drinking alcohol quicker than to other, less emotionally charged words.

Applying this this to "real life" situations raises the possibility that people who are trying to avoid problem drinking will nonetheless have their attention drawn to ideas associated with drinking. This is speculation at this stage so don't worry that you are not fully in control of the recovery process. Ultimately it is your decision whether or not you choose to drink - this research will not alter that basic fact.

Frank Ryan
Clinical Psychologist

APPENDIX V

RIVERSIDE HOSPITALS

RESEARCH ETHICS COMMITTEE

FROM: Dr J.N Harcourt Webster - Chairman

Telephone: 081 846-7535
081 460-5504

Frank Ryan Esq., C Psychol AFBPsS,
Consultant Clinical Psychologist,
The Riverside Mental Health Unit,
Clinical Services Team,
5 Wolverton Gardens,
London W6 7DY

4th March 1994

My Ref. -----/JNH-W

Dear Mr Ryan,

SELECTIVE INFORMATION PROCESSING AND ADDICTIVE BEHAVIOUR.

Thank you for the letter of the 24th February accompanying the questionnaires for this study. They raise no problems on an ethical basis.

Enclosed is the formal Letter of Approval; such provisos as apply are set out in that letter.

I trust that all goes well and I look forward to hearing of your success.

With best wishes.

JN HARCOURT-WEBSTER, MD, FRCPath.,

Research Ethics Committee
Estates Department
Charing Cross Hospital
Fulham Palace Road
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